THIRTEENTH ILLINOIS CUSTOM SPRAY OPERATORS' TRAINING SCHOOL

SUMMARIES OF PRESENTATIONS

January 25-26, 1961

Urbana, Illinois

This training school is presented specifically for commercial applicators of agricultural chemicals by the University of Illinois College of Agriculture, Agricultural Extension Service, and Illinois Natural History Survey, but is open to all persons involved in the handling of agricultural chemicals. This school promotes the proper, timely and wise use of agricultural chemicals. We gratefully acknowledge the assistance of officers of the Illinois Association of Aerial Applicators and the Agricultural Spraying Association in planning the program. Abstracts in this manual bring to you the latest research information, but do not constitute positive recommendation unless so stated. Statements made herein are the responsibility of either the speaker or the institution he represents. <u>Reproduction and publication are permitted only with the approval of each author.</u>

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THE ILLINOIS AGRICULTURAL EXTENSION SERVICE WELCOMES YOU AS A COOPERATOR

J. B. Claar

It is with genuine pleasure that I welcome you to the University of Illinois to participate in the custom spray operators' school. I sincerely hope that the school will meet your expectations and that you will find the information which you obtain here useful to you in the year ahead. We welcome you as a cooperator in this important phase of agricultural education.

This cooperation is a two-way street. We need to know your experiences as you work with families in applying materials. Especially we need to know the areas needing further research. However, it is important that you know the up-to-date recommendations for using the various materials on Illinois crops, for you plan an important role in disseminating information. Research by several groups indicates the important role you play in providing information to farm operators. It is a challenging job, for new chemicals are becoming available every day and it is not unusual for chemicals that are considered safe at one time to be declared unsafe at another.

That this is a fast changing area, requiring constant study in order to do the job well, is underscored by the activities of the Food and Drug Administration. We have devised a system in connection with our Federal Extension Service, which works closely with the Food and Drug Administration, to stay up to date on the various regulations pertaining to the use of chemicals. We have a staff member, designated as the contact man, who is to receive notice almost instantaneously of any changes in regulations on the use of chemicals. We hope that you will be alert to such communications so that we will be properly advising producers in the state concerning the use of farm chemicals in the production of their crops.

It is important, too, that we be alert to the economics of applying spray materials. Our farm records indicate the tremendous increase in costs that have faced farm operators. When we compare 1951-52 with 1958-59 results on the same farms, we find that farmers have greatly increased their output and made much more intensive use of their farm land. However, the increasing costs associated with production and the decline in farm prices that occurred in this period resulted in a decline in farm production. The farmer's situation might be compared with that of the businessman who conducted a major overhaul of his business, shaking out all of the dead wood and increasing efficiency to the maximum, only to find that his net income was lower at the end of the period. It has been discouraging to our farmers and has made them extremely cost-conscious. The increase in the cost of farm imputs has been a contributing factor, and we must not be a party to encouraging the needless application of spray materials.

We believe we have a staff here at Illinois that is well trained and informed concerning the level of infestation that it is economic to treat as well as the area of spray materials that will provide effective control. We hope it will be possible to maintain close contact so that we can get information to you quickly and provide essential service to you throughout the year. We are pleased to have you here cooperating with us in this important area of agriculture.

FARM FLY CONTROL DEMONSTRATIONAL TEST PROGRAMS, 1960

Steve Moore III

Twelve dairy farms on DHIA test in four counties along the northern Illinois border were used in these demonstrational tests. The counties were Stephenson, Winnebago, Boone, and McHenry. Three different fly control programs were compared in each of the four counties so that each program was replicated four times. The three types of programs were as follows:

1. Residual barn spraying plus use of a repellent spray on half of the herd and a standard stock spray on the other half.

2. Barn fogging with either a portable or a permanent system plus use of a repellent spray on half of the herd and a standard stock spray on the other half.

3. No barn treatment, but use of a repellent spray on half of the herd and a standard stock spray on the other half.

The basic manufacturers supplied the insecticides and repellents free of charge. Their contribution was a sizable one and was much appreciated. The materials that were used consisted of 25 percent Diazinon wettable powder, 24 percent (or 2 pounds per gallon) ronnel emulsion concentrate, pyrethrin fogging concentrate containing 0.1 percent pyrethrins plus 1.0 percent piperonyl butoxide, 0.4 percent R-326 synergized repellent spray, and 0.5 percent Tabatrex synergized repellent spray.

The sanitation program on all 12 farms was good. The farmers received instructions on use of the materials, but basically they followed label directions. Fly treatments in all herds started in early to mid-June and continued until mid-September, or about three months. Face fly baits containing 0.2 percent DDVP in corn sirup were applied to the foreheads of all cattle in each herd from mid-July to mid-September.

Farms on which residual sprays were used had the fewest flies. Control was rated good to excellent. Farms on which foggers were used had noticeably more flies, and control was rated fair, with a range from good to poor. Farms on which no chemical control was used had high fly populations.

Table 1 summarizes the percent of average daily production per cow from July through October, using June as the base month (100%). The data indicate that, when residual barn sprays were properly used,the low-cost standard stock sprays adequately protected dairy cattle against attack by biting flies. There was a 2.21 percent production increase in favor of the repellent-type sprays over the standard stock sprays in herds in which daily barn fogging was practiced. However, in herds where no chemical house fly control measures were employed, the repellent-treated cattle outproduced those treated with a standard stock spray by 7.45 percent.

Table 1. Percent of Average Daily Production per Cow From July to October, 1960, Using June as the Base Month (100%)

Type of program	No. herds	Repellent-treated cows	Stock-spray-treated cows	Percent increase for repellent-treated cows
Residual barn spraying and repellent	3	71.66	71.96	-.30
Daily barn fogging and repellent	2	72.21	70.00	+2.21
Repellent only	3	82.98	75.53	+7.45
Average		75.62	72.50	+3.12

Table 2 gives the cost performance value for the various programs. Herds in which residual barn sprays were used showed no benefits from a higher priced repellent spray than from a lower cost stock spray. Herds in which fogging was used spent 45 cents more per cow for repellent sprays than for the stock sprays, but gained 117 pounds of milk per cow because of increased fly protection, resulting in a profit of $3.94 per cow after deduction of the added cost of the repellent. Herds in which no chemical control was used spent 53 cents more per cow for the repellent sprays than for the stock sprays, but gained 393 pounds of milk per cow because of increased fly protection, resulting in a profit of $14.21 per cow after deduction of the added cost of the repellent.

Table 2. Cost Performance Values for Dairy Farm Fly Control Programs in Stephenson, Winnebago, Boone, and McHenry Counties, Illinois, 1960

Type of program	Cost per cow: Residual or fogger	Cost per cow: Repellent	Cost per cow: Total	Cost per cow for stock spray	Increased cost per cow for repellent	Increased milk per repellent treated cow over stock-spray-treated cow for 4 months (lb.)	Value of increased milk per repellent-treated cow	Profit per repellent-treated cow over stock-spray-treated cow
Residual and repellent	1.22	1.31	2.53	.94	.37	0	0	0[a]
Fogger and repellent	1.57	1.57	3.14	1.12	.45	117	4.39	$ 3.94[a]
Repellent only	--	1.86	1.86	1.33	.53	393	14.74	$14.21[a]

a/ The theoretical profit, after deducting the $2 to $3 per cow treatment costs, from treatment compared with no treatment was between $25 and $30 per cow for the 1960 season.

MOLD PREVENTION IN HIGH-MOISTURE CORN

J. F. Tuite and G. W. Isaacs

Preventing mold growth is very important in preserving grain. Air-tight storage using a variety of structures, plastic-lined metal bins, gas tanks, epoxy resin-lined concrete bins, conventional silos fitted with tops, and glass-lined bins, is increasing in use on farms to preserve corn for feed. Respiration of the grain and microorganisms decreases oxygen and increases carbon dioxide levels to where harmful storage molds are inhibited, although yeasts may continue to grow.

Many fungicides are unable to inhibit molds on grain, and the majority of these are disqualified on the basis of food and drug laws. Sodium metabisulfite (trade name, Binstat, by Monsanto Chemical Company) appears to be a promising grain preservative because of its acceptance by the Food and Drug Administration and the U.S.D.A., its use in preserving silage, and the satisfactory results of some field tests done by Monsanto and some preliminary tests done by us. Several commercial grain dealers and processors in the United States are using this chemical on corn and milo with moisture up to 20 percent for three to five months in non-air-tight storage.

Sodium metabisulfite is a crystalline powder that decomposes in the presence of moisture to produce sulphur dioxide gas. The manufacturer recommends applying 0.225 pound per bushel or 8 pounds per ton of grain immediately before storage. The cost of treatment is about 2 cents per bushel. The chemical should not be used on seed grain, wheat or rye, since it kills the seed and is reported to destroy the baking and milling quality of the grain. Users should expect a temporary commercial objectionable odor and an inaccurate moisture test by electric moisture meters.

Preliminary studies at Purdue indicates that sodium metabisulfate will delay the spoilage of ensiled high-moisture corn in self-feeders for hogs. The feeders may be filled every fourth day instead of daily in warm weather. Use of the chemical to retard the spoilage of high-moisture corn in top-unloaded conventional silos is also being proposed. Tests are under way to evaluate the use of holding large quantities of high-moisture corn until it can be dried with a low-capacity drier. Laboratory tests indicate that corn may be safely stored for at least six weeks at 20 percent at 75-80° F. No recommendations based on the research at Purdue are available at this time.

EFFECT OF RAINFALL AND SOIL TEXTURE ON PRE-EMERGENCE RESULTS

E. L. Knake

Most of our pre-emergence herbicides are dependent on rainfall to move them into the upper 1 or 2 inches of the soil where weed seeds germinate. To have the equivalent of one-half inch of rain on an acre of land, we would need about 13,500 gallons of water. The 5 or 10 gallons of water applied with a sprayer is merely used to apply the herbicide uniformly and is of no significance in getting the chemical into the soil.

We need enough rain to move the chemical into the zone where the weed seeds germinate, but too much rain can leach some of the more soluble chemicals through the weed seed zone. For most pre-emergence herbicides, we need the rain within at least two weeks after application in order to control weeds effectively.

What is the probability of having the desired amount of rainfall at the desired time?

Table 1. Precipitation Probabilities at Urbana, Illinois*

Amount of rainfall	Percent probability of receiving indicated amount of rainfall during two-week period in May or June
1/4 inch	93
1/2 inch	85
3/4 inch	75
3 inches	18

*Based on data from North Central Regional Publication 115, "Precipitation Probabilities," June 1960.

Because the more soluble herbicides require less rainfall to move them into the zone where the weed seeds are germinating, they have a higher probability of being effective than the less soluble herbicides, which require more rainfall. However, occasionally excessive rains leach the more soluble herbicides too deeply, whereas that is not likely to happen with the more insoluble chemicals.

If a given amount of rainfall is required within one week rather than within two weeks, the probability that the rain will be received, and hence that the herbicide will be effective, is further decreased.

As a rule of thumb, we can expect favorable rainfall for most of our present pre-emergence herbicides about three out of four years.

What happens to a herbicide after it enters the soil depends not only on the nature of the herbicide, but also on the physical properties of the soil and the chemical and biological processes operating in the soil.

Soil texture is one of the major soil characteristics influencing the kind and rate of pre-emergence herbicide to be used. Texture refers to the coarseness or fineness of the soil. The proportion of the various sizes of particles--

sand, silt, and clay--found in a soil determines the textural class. We can group our soils into the following 12 textural classes:

Fine	Moderately fine	Medium	Coarse and very coarse
Clay	Silty clay loam	Loam	Sandy loam
Silty clay	Clay loam	Silty loam	Loamy sand
Sandy clay	Sandy clay loam	Silt	Sand

In addition to clay, silt, and sand, soils also contain organic matter. If a soil contains over 18 percent of organic matter, it is called a muck or peat. The major difference between peat and muck is that muck is in a more advanced stage of decomposition.

When climate, age, degree of aeration, and cropping conditions are similar, the organic-matter content of soils generally increases with their clay content.

Not only do herbicides differ in the way in which they are adsorbed by clays and organic complexes in the soil but, to add further to this complex picture, we have several different types of clay minerals, such as kaolinite, montmorillonite, and illite, as well as various kinds of organic matter influencing the fate of herbicides in soils.

Although we have much more to learn about the influence of this complexity of factors on herbicides, our present knowledge can help to guide us in selecting herbicides and the rates to use on various soil types.

Relatively soluble pre-emergence herbicides, such as CDAA (Randox) and 2,4-D ester, are not recommended for coarse-textured soils. In coarse-textured soils, the relatively soluble herbicides may leach past the zone of weed seed germination and thus be ineffective. Herbicides to which the crop does not have a relatively high degree of tolerance may leach down around the germinating crop seed and damage it.

Although Atrazine and Simazine are being used successfully at relatively low rates on coarse-textured soils, higher rates are recommended for soils of finer texture with higher amounts or organic matter. While a rate of 2 pounds has given good control on some of our coarse-textured soils with low organic matter, twice this rate has been necessary on some of our fine-textured soils with high organic matter. Absorption as well as adsorption by clays and organic complexes offers at least a partial explanation for the apparent need to use these higher rates.

MANGANESE DEFICIENCY IN ILLINOIS

S. W. Melsted

The occurrence of manganese deficiencies in soybeans and oats is increasing in Illinois. The soils involved are usually neutral to alkaline in reaction and usually tend to be wet, or have restricted drainage, in the early spring. No satisfactory soil test for manganese is available to determine areas where deficiencies may occur.

The appearance of manganese deficiency symptoms in crops is influenced by weather. A cool, wet spring will enhance deficiencies, while a warm, dry spring may completely prevent the deficiency from developing. For this reason the response of crops to manganese fertilizer treatment depends largely upon weather conditions. If a warming trend in the weather coincides with the time of treatment, little or no response to fertilization may occur.

In Illinois, manganese deficiencies in soybeans and oats have been verified by plant symptoms, by plant analysis, or by fertilizer trials. Fertilizer trials have usually involved spray applications of 10 to 20 pounds of manganese sulfate per acre. Responses for soybeans have varied from zero to 12 bushels an acre, depending upon the season and timeliness of the application. Manganese deficiencies may usually be expected in soybeans if the total manganese content of the plant drops below 25 parts per million. Deficiency symptoms are usually present on plants containing less than 20 parts per million of manganese.

When manganese deficiency symptoms appear on soybeans, spray applications of 10 to 20 pounds of manganese sulfate an acre are suggested. For spray applications, 10 pounds of manganese sulfate in 25 gallons of water represents a safe maximum concentration to avoid leaf burn. Soil applications of manganese sulfate, especially after the crop is established, are usually not effective.

WEED CONTROL IN SOYBEANS

W. O. Scott

Proper seedbed preparation followed by timely cultivation will control weeds in soybeans. In this method of control, timeliness is extremely important. If weather or some other factor prevents cultivation at the proper time, especially when weeds are small, weeds will become firmly established and soybean yields will be reduced.

The use of pre-emergence herbicides provides some insurance against the adversities of weather. The successful control of weeds by a pre-emergence herbicide also depends on weather conditions. Fortunately the kind of weather that prevents timely cultivation is also the kind needed for good weed control by pre-emergence chemicals.

Three herbicides have F.D.A. approval for pre-emergence weed control in commercial soybeans. They are Randox, Alanap, and CIPC. Randox is specific for annual grass weeds and seldom gives control of broadleaf weeds. This herbicide is seldom injurious to the germinating soybean and is first choice where grasses are the predominant problem.

Alanap controls annual grasses and most broadleaf weeds. This herbicide seldom controls annual smartweed, which is a common weed in soybean fields. To overcome this disadvantage, a few states have suggested a mixture of Alanap and CIPC. This combination has not been tested extensively in Illinois; however, it may be used experimentally where smartweeds are a serious problem. Both CIPC and Alanap present some hazard to soybean stands.

Amiben has been approved for use on soybeans grown for seed only. This herbicide has looked good in Illinois.

GRANULAR INSECTICIDES FOR ROW TREATMENTS AGAINST THE NORTHERN CORN ROOTWORM

J. W. Apple

The northern corn rootworm, Diabrotica longicornis, and the western corn rootworm, Diabrotica virgifera are controlled by most midwestern farmers with row treatments at planting time. Granular formulations of aldrin and heptachlor are the common products for such applications. Initially, 20 percent formulations on 30/60-mesh clay were used with very satisfactory results. During the last two years, however, a shift to coarser granules has occurred quite independently of any supporting research findings. Because of this trend, an experiment was designed and carried out at Arlington, Wisconsin, during 1960 to evaluate certain granular insecticide variables in relation to the control of northern rootworms when such formulations were drilled in the soil above the seed at planting time.

In a comparison of insecticide concentrations and granule sizes (Table 1) where heptachlor was used at 0.25 pound per acre (½ recommended rate), it was found that best control was associated with low concentrations and fine particle size. This has prompted us in Wisconsin to suggest the use of 10 percent aldrin or heptachlor on a granule of about 20/40-mesh size.

Table 1. Factorial experiment to determine the influence of insecticide concentration and granule size on rootworm control

Concentration on granules	% lodging	Granule size	% lodging
5% heptachlor	6.8[1/]	30/60 mesh	6.6
10% "	8.0	20/35 "	6.6
20% "	18.7	15/30 "	9.3
		8/15 "	22.2
Untreated	96.6		

1/ Means associated with vertical lines not significantly different.

The previous experiment involved clay granules sold under the name Attaclay. Limited comparisons of Attaclay, Florex, and Creek-o-nite clays failed to show any true difference between these products when used as carriers for heptachlor insecticide.

Thirteen candidate insecticides in granular formulation were evaluated against the rootworm at one and two pounds of actual insecticide per acre. The Shell product, SD-4402, and phorate each gave good protection against lodging, while Diazinon, Di-Syston, and Trithion showed moderately good results. The remaining eight insecticides were little or no better than the control.

Yield benefits from the use of granular insecticides in this experiment were quite impressive. There was a difference of 23.3 bushels per acre between the untreated plots and those treated with the recommended 0.5-pound-per-acre rate of aldrin and heptachlor. Thus one can say that rootworms in this planting caused a 27.8 percent yield loss (23.3/83.9) or, to express another way, the standard treatments produced a 38.4 percent yield increase over no treatment (23.3/60.6). This unusually high loss from rootworms resulted from small plants (seeded 5/25-26) being attacked by an average of 45 worms per plant.

CONTROLLING HESSIAN FLY IN WHEAT WITH SYSTEMIC INSECTICIDES

J. H. Bigger

Since 1957 we have been investigating the possibility of controlling the Hessian fly in the fall with two systemic insecticides, namely, Thimet phorate and Di-Syston.

After three years of small-plot testing, we decided to give the materials large-scale tests on farms. Thimet (phorate) was approved for such tests in 1959 and has been used for two years. Di-Syston was approved in 1960, and both it and Thimet were used in 1960. These tests were made in cooperation with Dr. Petty and interested farm advisers and farmers. They were conducted on 18 farms in 10 counties in southern Illinois.

The insecticides were applied as granules at the rate of 1 pound of technical insecticide per acre. They were usually applied through the grass seeder box on a grain drill. In some cases they were mixed with fertilizer and applied as a combination. In one case the granules were mixed with the seed in the grain drill. This method was not successful.

Seed of a susceptible variety was planted 10 to 14 days before the recommended date in each county with and without treatment. In 10 cases grain of a resistant variety was planted in the same field at the same time. In nine cases grain of the susceptible variety was also planted in the same field at the recommended date. In two cases the seed of the resistant variety was probably contaminated by mixing with a susceptible variety.

The treatments were eminently successful in preventing infestation, as can be seen from Table 1. They reduced both extent and intensity of the infestation. Planting at the recommended date is still successful in preventing fall infestation.

So far yields have been obtained only on the crop harvested in 1960. Table 2 gives these data. Except as noted, all yields are for a susceptible variety. Treating an early-seeded susceptible variety increased yields in all categories, and grains were sufficient to produce a good profit. However, yields also increased when a susceptible variety was seeded at the recommended date, and where possible this is a basic recommendation.

Further intensive small plot research is in progress. We are examining dosage rates to see whether cost of treatment may be reduced without loss of too much efficiency. We are also examining other materials that might be available to control this pest.

Our basic recommendation for preventing Hessian fly damage is and will continue to be seeding at the recommended date or using a resistant variety (Dual, Ponca, or Monon). However, if a farmer finds it advisable to seed early with a susceptible variety, we recommend the use of Thimet at the rate of 10 pounds of 10 percent granules or 20 pounds of 5 percent granules, applied through the grass seeder box of a grain drill. <u>Such seedings must not be grazed by livestock.</u> Thimet has label approval for use on wheat for this purpose. Di-Syston does not yet have label approval, but will be included in our recommendations when and if it receives such approval.

Table 1. Hessian Fly Abundance on Demonstration Plots, Falls of 1959 and 1960

	Susceptible variety seeded about 10 days early				Resistant variety seeded early		Susceptible variety seeded at recommended date	
	Percent of plants infested		No. of flies per 100 plants		Not treated		Not treated	
Year	Treated area	Untreated area	Treated area	Untreated area	Percent of plants infested	No. of flies per 100 plants	Percent of plants infested	No. of flies per 100 plants
1959	1.8	58.0	2.4	209.0	6.8a/	12.2a/	0	0
1960	1.1	23.4	2.9	66.5	4.0a/	7.7a/	0.3	0.3
Two years	1.4	38.3	2.7	129.8	5.1 (2.5)b/	9.5 (3.6)b/	0.2	0.2

a/ Each year one field planted with seed probably contaminated with a susceptible variety.
b/ Average with questionable plots eliminated.

Table 2. Yields of Wheat on Experiment-Demonstration Plots, 1960 Harvest

	Yield in bushels per acre			
	Early seeding date			
Treatment	Treated	Untreated	Resistant variety	Recommended seeding date
Early-seeded resistant variety, 1 test	32.5	34.0		26.7
Early-seeded, treated vs. untreated, 8 tests	33.9	27.7		
Early-seeded (treated and untreated) vs. resistant, 4 tests	27.7	21.7	30.2	
Early-seeded (treated and untreated) vs. recommended date, 4 tests	34.5	27.9		40.0
Early-seeded (treated) vs. recommended date, 5 tests	37.1			41.7

JOHNSONGRASS CONTROL ON HIGHWAYS

O. Hale Fletchall

Johnsongrass is one of the most destructive and tenacious weed pests. Since this weed produces the greatest losses to agriculture, it is ultimately a pest to everyone. It reduces efficiency of production, causing higher priced food and clothing to all.

Agriculture, however, does not have a monopoly on losses. The weed chokes drainage and irrigation ditches, makes work where it grows unpleasant and inefficient, and creates a serious fire hazard around buildings and other installations.

The Missouri State Highway Department has emphasized that it is participating in a Johnsongrass control and eradication program not only because it has a legal obligation, but because the control of Johnsongrass on highway right of ways benefits both the State Highway Department and the general public. Control and eradication of Johnsongrass will save money in highway maintenance costs and will save lives and prevent injuries by decreasing the number of motor-vehicle accidents. A right of way infested with Johnsongrass might need six to eight mowings during a growing season compared with none or perhaps only two where different conditions prevail. It costs a great deal of money to control Johnsongrass on highway right of ways, but the Missouri State Highway Department feels it is a paying investment on a long-term basis.

The control of vegetation along highways is primarily for two purposes--appearance and safety. The first reason is obvious and needs no explanation.

Safety is, of course, the more important reason. With its rapid growth and its tall habit of growth, Johnsongrass presents a hazard to drivers by reducing visibility and making shoulders dangerous. Keeping the growth short along highways improves the sight distance of drivers and reduces the hazards of accidents at "blind" road junctions and curves. It also provides a safe place for motorists to pull off on the shoulders and stop their cars in cases of emergencies.

The Nature of Johnsongrass

An understanding of the nature of this pest will be of help in considering control measures. Full identification is beyond the scope of this paper, but all persons involved in plant control on any land should be able to recognize Johnsongrass seed, seedlings, and shoots from rhizomes.

There are some characteristics of Johnsongrass that make it particularly difficult to control:

1. Johnsongrass is an abundant producer of seeds. The seeds are spread far and wide by flood waters, trucks, trains, and machinery. They occur in crop seed, feed, mulching materials, and bedding.

2. Johnsongrass also produces large, fleshy rhizomes (underground stems). These rhizomes store large quantities of food, giving the plant the ability to survive unfavorable

conditions. There are two known infestations as far north as Michigan.

3. Johnsongrass has some seed dormancy. You can kill every growing Johnsongrass plant in an area, and seedlings can still reinfest the area.

4. This plant has an unusual ability to adapt itself to its environment. For example, mowing will thin and weaken Johnsongrass, but it will not eradicate it.

5. Rapid rhizome development and seed formation make the timing of control operations difficult, and poor timing is costly.

6. Johnsongrass is more resistant to known herbicides than most weeds. This is due partly to the large proportion of the plant which grows underground.

Some Effective Chemicals

A great deal of research needs to be done to find more effective and more efficient ways to control Johnsongrass--especially on noncrop land. Past research and experience show, however, that it can be done.

Sodium chlorate and some other soil sterilants give good control. Sodium chlorate presents some fire hazard, and in some cases the soil-sterilizing effect is objectionable. Also, the cost of these materials per acre treated is high.

TCA is safer and sterilizes the soil a shorter time, but in experiments in Missouri it has not been as effective as dalapon.

Dalapon appears to be the most promising chemical for Johnsongrass control. It is sold as "Dowpon" in agricultural distribution channels and "Radapon" in industrial channels. Both materials contain 74 percent acid equivalent of dalapon. This chemical is a general grass killer with a relatively short period of residual action in the soil. Its toxicity to man and animals is about the same as that of table salt. It is relatively cheap, but often requires two or three applications per season. Dalapon appears to be both leaf-absorbed and root-absorbed. Some research indicates that it is most effective when there is enough rainfall after application to allow both root and leaf absorption to take place.

Planning a Control Program

Only a short growing period after the effects of dalapon spray have largely disappeared will allow Johnsongrass to produce rhizomes that can survive the winter and increase the infestation. It is important, therefore, to continue periodic treatments once they are started. If available funds will not allow a complete spraying program to be applied to all of the Johnsongrass-infested land, the areas to be treated with dalapon should be determined at the beginning of the program. No more area should be included than can be given a complete program.

Areas not included in the spraying program should be mowed frequently. Mowing will prevent additional infestation from seed and will weaken the plants, making subsequent chemical treatments more effective.

If all of the Johnsongrass-infested land can not be given a complete spraying program, the areas selected to receive the program should be those with the thinnest stands and the newest infestations. Johnsongrass is easier to kill in thin stands and new infestations than in old, thick stands. Furthermore, some delay in initiating dalapon treatments on old, thick stands will be of little consequence--they are already about as bad as they can get.

It is realized that the importance of getting rid of Johnsongrass is greater in some areas than in others, regardless of the stand and the age of the infestation. This will need to be considered in selecting areas to receive the spray program.

The Broadcast Spray Program

A spray program should consist of repeated applications of 7.4 pounds per acre of acid equivalent of dalapon (sodium 2,2-dichloropropionate). This would be 10 pounds per acre of "Radapon," which contains 74 percent of the acid equivalent of dalapon.

The initial application of the season should be made as soon as possible after the Johnsongrass has grown to a height of about 12 inches. An early mowing when the largest Johnsongrass plants are 8 inches tall may precede the first spraying if it is necessary to prevent part of the Johnsongrass from getting too tall before all of the initial spray can be applied or to cut back scattered, early-emerging plants to allow more plants to emerge and receive the spray treatment.

Spraying should be repeated when regrowth is about 12 inches tall or, in cases in which the initial spraying did not give a good top kill, when further dying back or suppression of growth has stopped and the plants start to recover. The second spraying will usually be necessary about five weeks after the first. With possibly slight detrimental effects as far as Johnsongrass kill is concerned, mowing to improve the appearance of the right of way can be done not sooner than three weeks after the first spraying.

A third spraying will probably be necessary. It should be applied according to the same Johnsongrass performance as the second spraying. This will probably be about six to eight weeks after the second spraying.

In making the applications, care should be taken to insure uniform distribution of the spray material. Research up to now indicates that the volume rate of water carrier has little influence as long as the material is uniformly distributed.

Spot Treatment

To save material and reduce chemical injury to desirable plants, scattered plants can be treated individually. The foliage should be wet with a solution of 14.8 pounds of acid equivalent of dalapon (20 pounds of "Radapon" containing 74 percent acid equivalent of dalapon) per 100 gallons of water. This treatment should be repeated on the same basis as the broadcast sprays discussed previously. It may be possible to reduce this concentration by 50 percent. This possibility has not been thoroughly tested by the Missouri Agricultural Experiment Station.

Mowing

Areas that can not be sprayed because of lack of funds should be mowed as frequently as the Johnsongrass reaches a height of 8 to 10 inches. This may be as often as once a week during periods of warm weather and good soil moisture. In no case should the Johnsongrass be allowed to form seed.

Timing of Spraying

Because of variations in rate of growth of Johnsongrass and degree of setback by spray treatments due to variations in weather, it is not possible to schedule spraying operations accurately. This difficulty in timing will always present a problem of schedule specifications for bid requests for contract spraying. This problem could be overcome by supplementing contract spraying with an increased amount of spraying by Highway Department personnel and equipment. Whatever method is used, a great deal of flexibility in the timing of spray operations is essential.

INSECT SITUATION FOR 1961

H. B. Petty

Insects in general were not so severe a problem in 1960 as in many other years, but certain ones, particularly the underground corn-feeding insects, were as abundant as usual.

The main activities in controlling field crop insects are summarized in Table 1.

Table 1. Acres of Field Crops Treated With Insecticides and Estimated Profit From Treatment, Illinois, 1960

Crop and insect	Acres treated	Estimated Profit*
Clover and alfalfa		
Cloverleaf weevil	4,852	$ 7,278
Potato leafhopper	19,715	29,145
Meadow spittlebug	1,913	1,913
Sweet clover weevil	9,414	94,140
Corn		
Soil treatment for seed and root feeders	1,891,399	$5,674,197
Cutworm	109,479	547,395
European corn borer	83,274	333,096
Corn leaf aphid	10,140	10,140
General		
Grasshopper	51,928	205,712
Total	2,182,114	$6,903,016

* Excluding treatment costs.

Soil insecticide use is still increasing, 1,891,399 acres being treated with aldrin or heptachlor this past year. Of this total 58 percent was row treatment and 42 percent was broadcast. Table 2 shows the percent of acreage treated by various methods. Note that, percentage-wise, use of granules is increasing, sprays are holding their own, and fertilizer mixes are decreasing. The only complaints from black cutworm attack again came from farmers who used row treatments.

Table 2. Percent of Acreage Treated With Soil Insecticides Applied by Various Methods, 1957-60

Year	In fertilizer	As spray	As granules
1957	71	23	6
1958	52	28	20
1959	44	26	30
1960	29	23	48

Black cutworms were about as abundant in 1960 as in 1959, but farmers took action more readily. They had to replant 151,665 acres in 1959, but only 115,294 acres in 1960. They treated 86,570 acres in 1959 but treated 109,479 acres in 1960.

Corn leaf aphids in late July were poised to increase to damaging proportions but did not become so widespread as in 1959. There was more than twice as much treatment in 1960 as in 1959. However, this past year we did see some fields that were more heavily infested than any we saw in 1959. Once we learn the proper timing of insecticides and the level of infestation that warrants their use, control of corn leaf aphid may become more common than it is today.

Corn borer infestations this past year were similar to those in 1959 for both first generation (Tables 3,4) and second generation (Table 5). About the same number of acres were treated in the two years. Pupation of first-generation borers ceased rather abruptly in early August in northern Illinois; otherwise there might have been a definite increase in second generation.

Face flies attracted more attention than any other insect pest in 1960. Present in 1959 over a wide area, they were found in low numbers on cattle in May, but the number had increased greatly by mid-August.

House flies attracted more attention in 1960 than they have for several previous years.

Methods of applying the insecticides are presented in Table 6.

OUTLOOK FOR 1961

Corn borers: With the present populations (Table 4, Map 1), we can only say that if a moderate amount of corn is planted early and weather is favorable for the borer, damage could occur north of a line from St. Louis to Paris, except possibly in extreme northeastern Illinois. This statement applies only to field corn, not to sweet corn.

Chinch bugs: Two areas in Illinois (Map 2) may have a chinch bug problem, but if this potential develops in 1961, there will have to be dry, hot weather and thin, open stands of small grains.

Grasshoppers: The potential for '61 is a light to moderate infestation in the area north of a line from Lawrenceville to Carthage. South of this line the potential is non-economic.

Spittlebugs: The area with the greatest potential problem--and it is only moderate--is again in northern Illinois (Map 3). Central Illinois will have a light potential and southern Illinois a non-economic potential. Little effort is made to control this pest, since hay is almost a surplus commodity in many areas.

Hessian fly: Populations were at a peak in 1956. They then decreased until 1958 but are now approaching another peak (Table 7). A dry fall and poor germination of early-seeded wheat in east-southeast and southeastern Illinois helped to keep the fall infestation low, but in west-southwestern and southwestern Illinois the population may increase this year.

Table 3. First- and Second-Generation Corn Borer Populations

	Oct. 1956	July 1957	Oct. 1957	July 1958	Oct. 1958	July 1959	Oct. 1959	July 1960	Oct. 1960
Northwest									
Ogle	148	7	50	25	124	11	211	18	160
Whiteside	292	7	65	19	165	10	184	6	76
Bureau	90	8	77	--	--	10	208	5	36
Mercer	408	21	171	47	164	2	100	1	132
Average	235	8	91	30	185	8	176	8	101
Northeast									
Boone	106	1	59	4	36	5	64	11	75
DeKalb	186	2	40	17	99	6	200	1	57
LaSalle	225	2	115	--	--	12	120	0	55
Average	173	22	71	10	68	8	128	4	62
East									
Kankakee	86	1	63	9	48	1	107	5	59
Iroquois	88	1	44	1	47	2	61	12	122
Livingston	127	--	--	13	93	3	85	3	129
Champaign	283	3	25	2	24	1	3	1	13
Average	171	2	44	6	53	2	64	5	81
Central									
McLean	161	0	18	4	134	6	118	5	247
Logan	---	8	34	1	98	1	12	2	54
Average	161	4	26	3	116	4	65	4	150
West									
Knox	353	17	102	13	203	4	108	26	135
McDonough	183	5	78	38	149	3	65	13	193
Average	268	11	90	26	176	4	87	20	164
West-Southwest									
Christian	--	8	55	1	73	2	36	15	114
Sangamon	--	25	83	1	35	1	14	1	90
Macoupin	--	30	99	1	50	1	127	36	192
Greene	--	--	--	1	40	1	69	13	234
Average		21	79	1	50	3	62	16	158
Over-all average	201	8	67	13	107	4	100	9	114

Table 4. Average First- and Second-Generation Corn Borer Populations (12-County Comparison)

Year	1st generation	2nd generation
1955	67	570
1956	94	203
1957	6	63
1958	16	103
1959	5	109
1960	9	117

Table 5. Corn Borer Fall Population Surveys in 36 Counties, 1953-1960
(County Averages Expressed in Borers per 100 Stalks of Corn)

	1953	1954	1955	1956	1957	1958	1959	1960
Northwest								
Jo Daviess	64	140	609	110	90	94	114	68
Winnebago	102	171	414	201	43	57	83	131
Ogle	153	422	852	148	50	124	211	125
Whiteside	177	340	401	292	65	165	184	76
Bureau	168	325	270	90	77	158	208	36
Mercer	582	763	382	408	171	164	100	132
Average	208	360	488	208	83	127	150	95
Northeast								
Boone	59	98	334	106	59	36	64	75
Lake	45	103	243	127	57	57	39	24
DeKalb	144	324	541	186	40	99	200	57
DuPage	117	134	395	104	111	55	59	65
Will	293	445	435	97	39	36	75	92
LaSalle	371	289	532	225	115	101	120	55
Average	172	232	413	141	70	64	93	61
East								
Kankakee	512	519	600	86	63	48	107	59
Iroquois	573	511	839	88	44	47	61	122
Livingston	405	677	887	127	21	93	85	129
Vermilion	125	323	840	135	30	34	11	41
Champaign	24	104	622	283	25	24	3	13
Average	328	427	758	144	37	49	53	73
Central								
Peoria	350	515	300	198	114	81	53	160
Woodford	504	524	343	169	97	168	121	205
McLean	180	490	628	161	18	134	118	247
Logan	51	140	291	211	34	98	12	54
Macon	8	98	359	404	31	31	28	29
Average	219	353	384	228	59	102	66	139
West								
Henderson	339	382	424	305	189	146	87	136
Knox	266	240	434	353	102	203	108	135
Hancock	59	224	215	94	244	192	64	278
McDonough	128	330	323	183	78	149	65	193
Adams	128	79	107	58	159	138	175	207
Brown-Cass	50	131	248	110	87	98	109	91
Average	162	231	292	184	143	154	101	173
West-Southwest								
Sangamon	17	38	238	208	83	35	14	90
Christian	9	17	117	227	55	73	36	114
Madison	24	4	53	50	45	29	33	111
Average	17	20	136	162	61	46	28	105
Southwest								
St. Clair	29	21	14	74	45	9	9	38
Average	29	21	14	74	45	9	9	38
East-Southeast								
Moultrie	20	23	225	122	27	53	9	29
Clark	21	20	47	16	10	16	27	20
Jasper	17	1	16	52	3	18	16	49
Lawrence	21	--	36	2	10	31	29	41
Average	20	15	81	48	13	20	20	35
AVERAGE, ABOVE 36 COUNTIES	170	256	378	161	70	86	79	98
AVERAGE, ALL COUNTIES SURVEYED	126	182	282	143	66	73	74	101

Table 6. Percent of Total Field Crops Treated by Commercial and Private Applicators in Illinois, 1954-60

	Percent of total acreage treated		
	Commercial		
Year	Airplane	Ground applicator	Individual
1954	18.3	20.2	61.5
1955	24.8	29.0	46.2
1956	24.8	24.8	50.4
1957	16.4	30.1	53.5
1958	3.0	19.5	77.5 1/
	10.8	28.3	60.9 2/
1959	2.6	14.5	82.9 1/
	9.5	18.6	71.9 2/
1960	5.6	11.9	82.5 1/
	17.5	14.0	68.5 2/

1/ Including soil insect control, which was not previously included in these estimates.

2/ Exclusive of soil insect control.

Table 7. Hessian Fly Populations, by Sections, July 1956-60

	Flaxseeds per 100 tillers				
Section	1956	1957	1958	1959	1960
West	3.1	2.2	1.6	8.0	4.4
Central	1.4	2.0	0.8	20.8	4.7
East	--	--	1.6	0.8	6.9
West-Southwest	13.1	4.9	3.4	16.4	18.0
East-Southeast	33.1	7.6	6.2	10.0	10.0
Southwest	12.8	6.7	2.9	5.4	10.7
Southeast	22.3	9.7	0.2	6.2	15.7
State Average	15.5	6.3	2.9	9.2	11.4

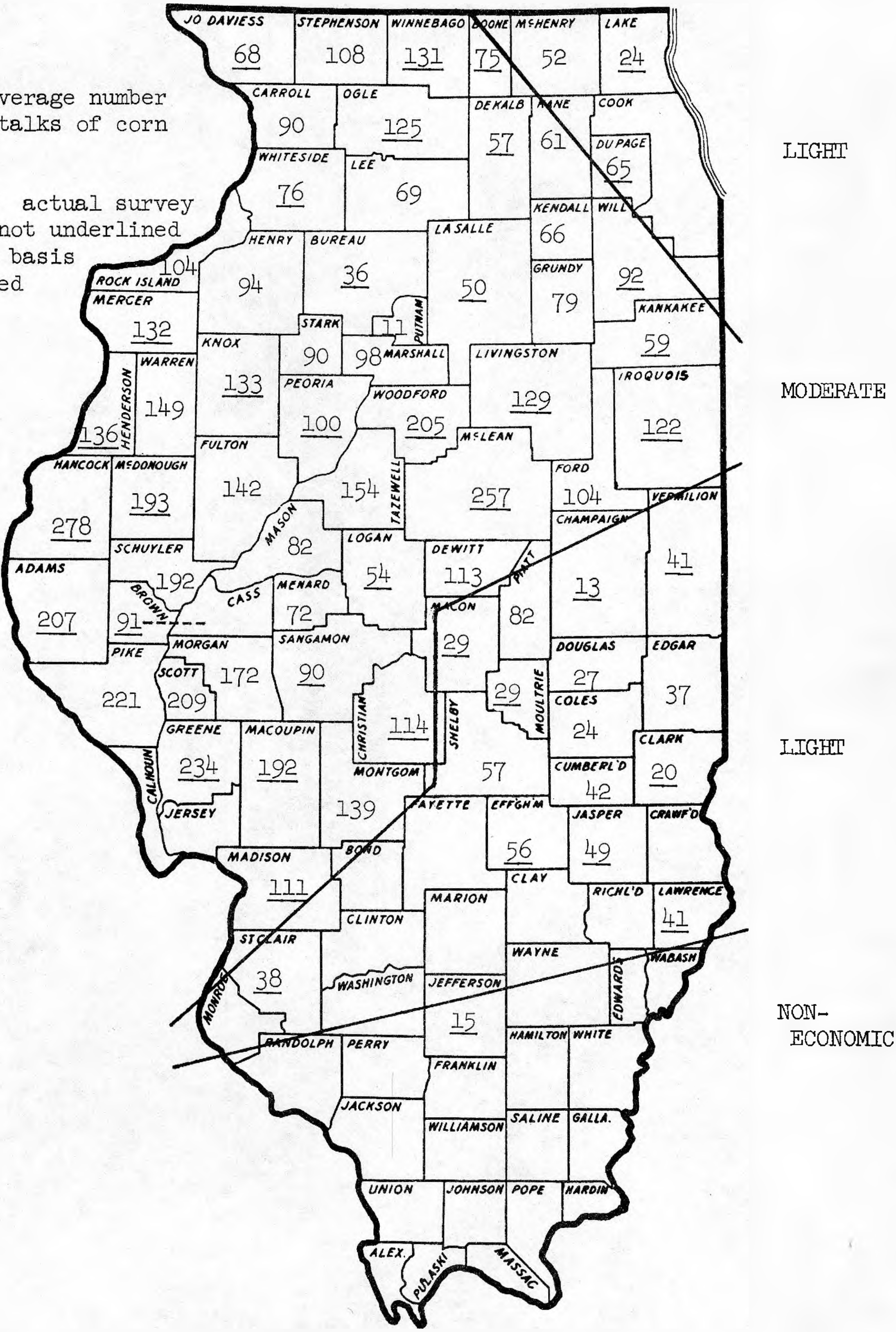
Grape colaspis: This pest was abundant in some areas in the south-central section of Illinois. We can expect it to be severe on corn or soybeans following red clover, lespedeza, or two years of soybeans.

Face flies: These flies apparently are established in Illinois, but the extent to which they will become a pest in the southern third of the state is yet to be determined. Farmers in the northern two-thirds may plan on late July, August, and early September as face fly time. Over-all weather conditions may change the degree of infestation, but until this new pest has been in Illinois long enough to determine its idiosyncrasies, we may as well plan to practice control.

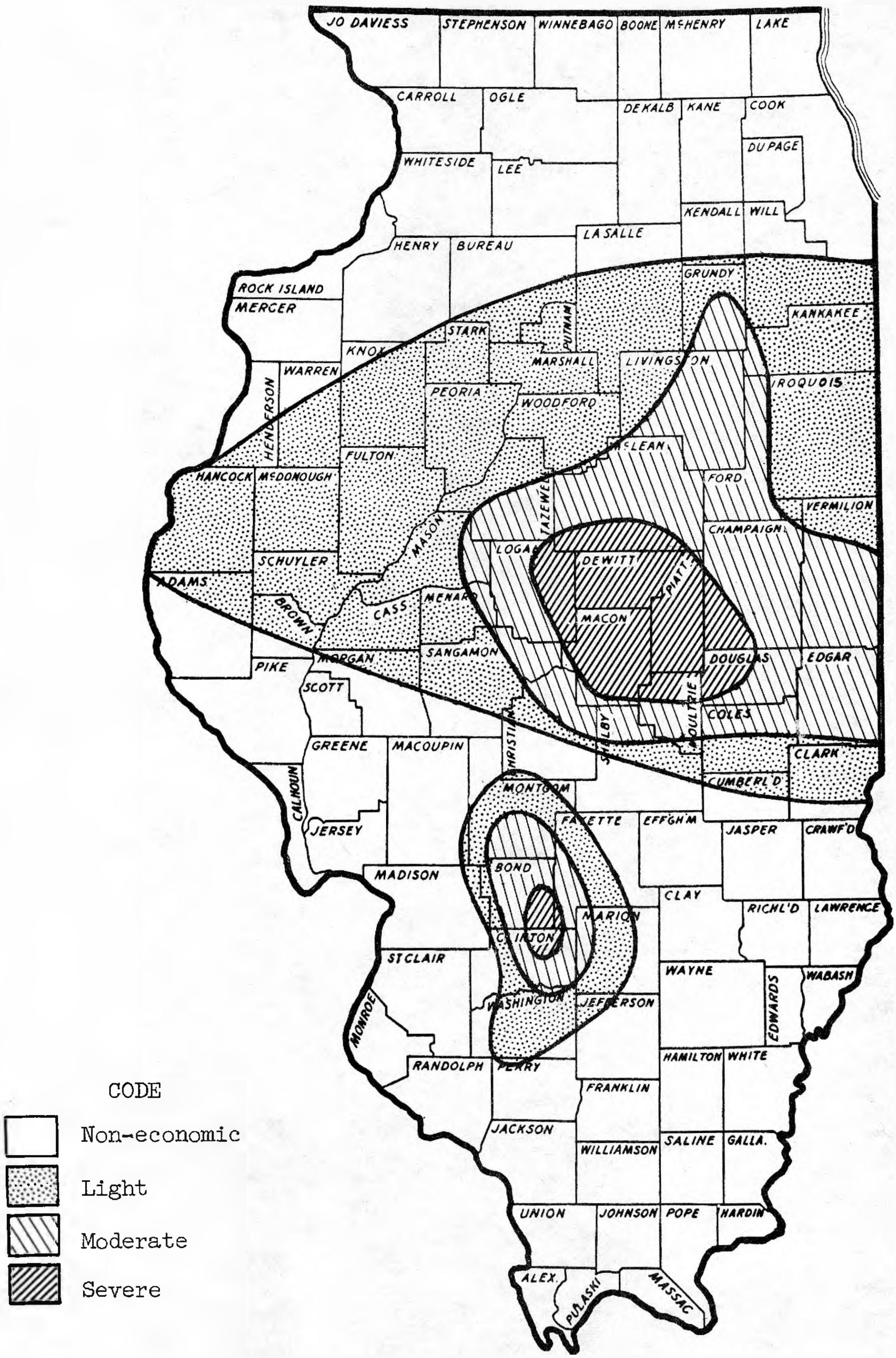
Map 1. 1961 Corn Borer Prospects for Field Corn

Figures represent average number of borers per 100 stalks of corn as of 10/1/60.

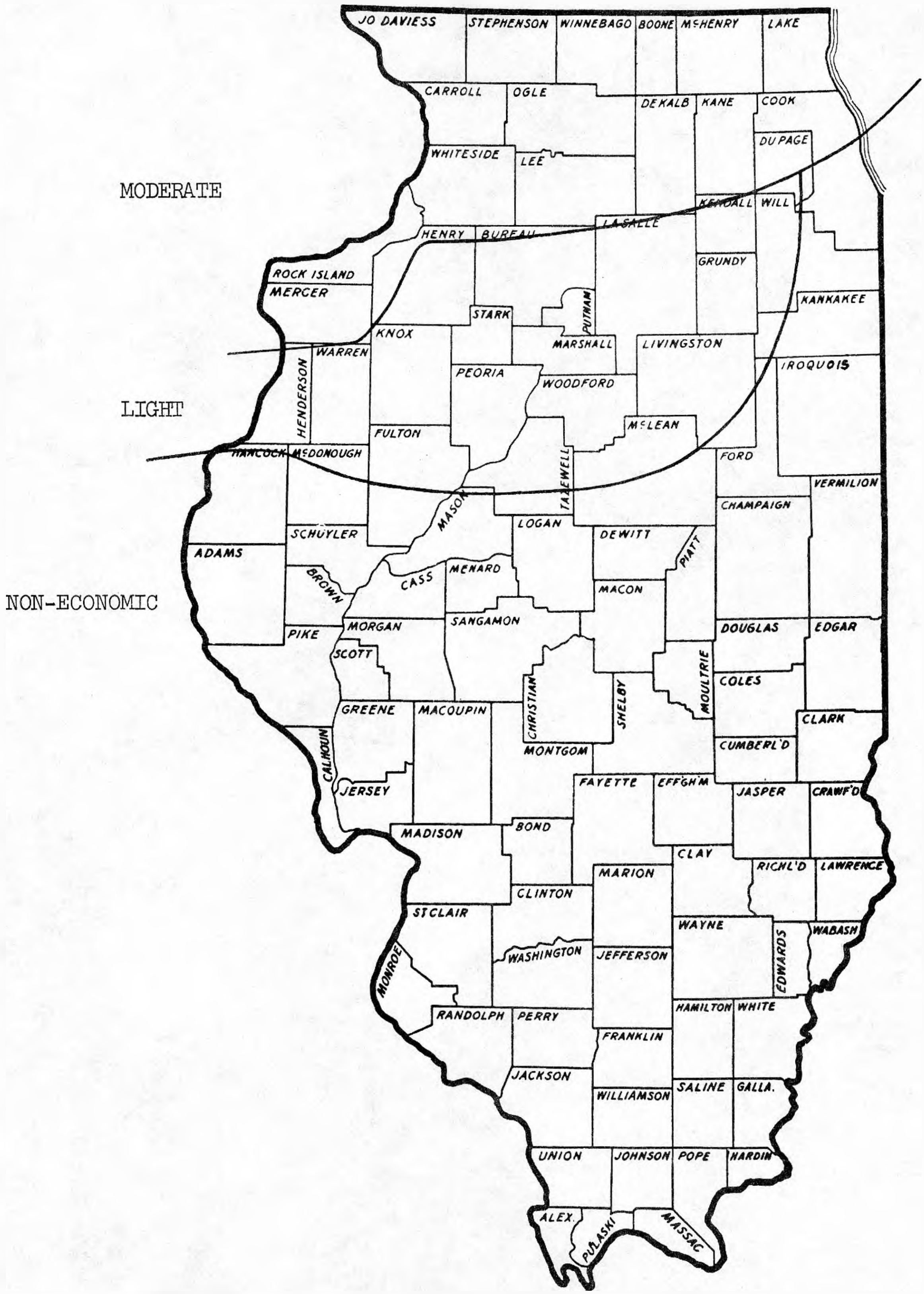
Underlined figures: actual survey populations; those not underlined are computed on the basis of adjoining surveyed counties.



Map 2. Chinch Bug Prospects, 1961



Map 3. Meadow Spittlebug Prospects, 1961



PENETRATION AND TRANSLOCATION OF 2,4-D AND 2,4,5-T

F. W. Slife

Soon after the synthesis and testing of 2,4-D, 2,4,5-T was introduced. Because it appeared to have about the same activity as 2,4-D and cost more to manufacture, it was not used to the same extent that 2,4-D was. Later, however, research workers found that it was highly effective on brush species, and since then it has become known as our standard brush killer.

A few investigators who have compared 2,4-D and 2,4,5-T on ordinary weeds have reached the conclusion that the two compounds are about equally effective in killing most weeds. They point out, however, that several weeds are much more sensitive to 2,4,5-T than to 2,4-D. They are wild cucumber, horse nettle, and white clover in lawns.

To determine the basis for this selectivity, radioactive 2,4-D and 2,4,5-T were applied to wild cucumber plants. Applications were made both on the leaves and through the root systems. At one, four, and eight days after application, the plants were harvested, freeze-dried, and mounted on paper. The mounted plants were then exposed to X-ray film, and the distribution of carbon 14 in 2,4-D and 2,4,5-T was determined. These studies indicated that there was no problem of penetration and translocation of 2,4-D. In fact, it apparently penetrated and translocated to a much greater extent than 2,4,5-T. But further studies indicated that, once 2,4-D entered the plant and was translocated to the different plant parts, it was quickly tied up into several conjugates that apparently were not effective in killing the plant; 2,4,5-T, on the other hand, was not tied up and even at the end of eight days could be recovered in the form of free 2,4,5-T.

This study further indicates that perhaps 2,4,5-T should be evaluated on some of the weed plants that 2,4-D does not do a good job on.

PROGRESS REPORT OF MOLYBDENUM (MOLY-GRO OR MOLY) ON SOYBEANS

A. L. Lang

Molybdenum (moly) is the most recent addition to the known list of elements essential to plant growth. Its requirement was first demonstrated in 1939 by Arnon and Stought. Average soils contain only small amounts, and as little as one pound an acre has been shown to be beneficial on deficient soils. Molybdenum is in the soil as an anion (MoO_4) and, like phosphorus, on acid soils its solubility is increased by liming. Conversely, it is almost completely insoluble at a high acid condition of pH 4. Plants probably take up a lesser amount of molybdenum than of any other minor element. In fact, the amount is so small that it is difficult to find unless accurate technics are carefully used.

Rock and superphosphate contain small amounts of molybdenum. As much as 20 parts per million has been found in Florida phosphate. The use of these materials may satisfy the needs on some soils and delay the need for molybdenum applications on others.

The use of molybdenum in crop and soil management practices is rather new because of its recently discovered benefits. Nevertheless, considerable work has been done with it, and these efforts are being continued in Illinois and in other areas where the response has been questionable.

The March 1956 issue of Soil Science gives a complete symposium on molybdenum which is a good reference on the subject.

Deficiency symptoms have been identified in more than 40 of the higher plants. Most noteworthy among them are vegetables, citrus fruits, and legumes. The deficiency may be due to conditions of the soil, climate, and fertility under which these plants are grown. Wheat, alfalfa, beans, and clovers have also shown striking effects of moly deficiencies in acid soils in New Zealand.

The symptoms may take different forms on different plants, but in the common farm, grain, and hay crops there is a yellowing of the interveinal spaces similar to that in manganese. Color plates of symptoms of several crops can be seen in the March 1956 issue of Soil Science (pages inserted between 208 and 209).

Apparently moly is essential in nitrogen fixation and reduction, but that cannot be its entire function because plants have been known to respond to moly over and above its need in the nitrogen processes.

Molybdenum, while necessary for plant growth, can be toxic to plants and poisonous to animals where used in even small overdoses or found in excessive amounts in soils. This is a striking example--and one to be heeded--of "where a little is good, but more is bad." Excess moly has been found in California, Oregon, and Florida soils. Deficiencies have been reported in 13 states and suspicious deficiencies in four others. The deficiencies have generally been reported on highly acid sandy soils and generally in vegetable crops or alfalfa. In most cases liming has released sufficient molybdenum to erase the deficiencies.

Conclusions relative to the desirable maximum and minimum limits of moly in soils and plants are not definite, although various workers have arrived at some tentative levels. In soils 2 parts per million have seemed to be adequate, although total moly in soils has not been closely correlated with experimental response. Soil samples representing 24 different conditions were studied and the results reported by Haley and Melsted from Illinois. These samples ranged from a low of 1.90 to 3.32 total parts per million of molybdenum, and more than 90 percent of this amount could be extracted by an acid mixture extraction solution. This work is reported in Soil Science Proceedings, Vol. 21, May-June issue, 1957, p. 136-319.

Maichele, working on the same soils with alfalfa, found no response to molybdenum fertilization.

Because of recent widespread sales promotion, many farmers have bought and used molybdenum in Illinois and surrounding states during the past few years. This use has brought a need for observations of farmers' results and extensive field trials to study the problem further.

In 1960 Probst studied the effect of moly on soybeans at five locations in Indiana. He found no effect on either growth or yield. The U. S. Regional Soybean Laboratory at Urbana made a chemical analysis of the beans from the plots studied by Probst. They found no effect on either percent of protein or percent of oil as a result of the molybdenum treatment.

A survey of 196 farmers who treated soybean seed in 1960 showed the following results: 47 reported yield increases due to the treatment, 63 reported no differences, and the rest reported that they could make no fair comparisons, generally because they had treated the whole field and left no checks. The increases, where reported, averaged from 1/2 to 4 bushels an acre.

In 1960 Johnson and Boone conducted field trials on six experimental fields, largely on the Cisne silt loams of southern Illinois. They treated the soybean seed in such a way as to apply about 1/4 ounce of sodium molybdate per acre. They placed the treated seeds in one planter box of a two-row corn planter and the untreated seed in the other box. Then they planted the beans in an otherwise normal way across all fertilized and unfertilized plots of each of the experimental fields in which the work was conducted. More than 200 fertility plots were involved in this study, and there were two replications of two rows each for each treatment on each plot. The rows were 40 inches wide, and the length of plots varied from 2 to 16 rods.

With one exception, the results showed neither a positive nor a negative effect of the molybdenum treatment on soybeans. However, at Carlinville all plots showed a consistent yield increase averaging about 3 bushels an acre. We are now obtaining chemical data on the beans and soil from this field. We are interested in knowing whether or not there is any chemical in the soybean seed or the soil that will correlate with the apparent increase in yields. On this field there was no apparent relation between lime, no lime, and other fertility treatments. However, in some other locations there were color and protein differences apparently due to molybdenum on unlimed soil. In some situations molybdenum retarded growth on the lime plots but did not significantly influence yield.

In summary, information available at this time does not favor the possibility of any widespread response to molybdenum treatment by soybeans on Illinois soils. However, the data are not sufficient to make positive specific and detailed local recommendations.

ABUNDANCE, DISTRIBUTION, AND FARM RESULTS WITH CONTROL MEASURES FOR THE FACE FLY IN ILLINOIS IN 1960

Steve Moore III

The face fly continued to be a serious problem on livestock in July, August, and September 1960. Infestations were of economic importance in approximately the northern two-thirds of Illinois (north of a line from Carrollton to Paris), as the attached map indicates. The general intensity of the infestation was greater in 1960 than in 1959. The face fly is fast becoming or already is our most serious insect pest of livestock in the northern two-thirds of the state. Dairy farmers who made daily applications of the sirup bait mixtures reduced face fly populations 40 to 75 percent. The average level of reduction was approximately 66 percent. At best the repellent materials provided no more than a 60 to 70 percent reduction in face flies for about a day.

Distribution and Abundance of Face Flies in Illinois in August, 1960

SEVERE
(20 to 150 per head)

LIGHT TO NON-ECONOMIC
(1 to 10 per head)

NONE

IMPORTANCE OF FORMULATING BAITS FOR FACE FLY CONTROL

W. N. Bruce

Bait applications controlled face flies in proportion to the effectiveness of the formulations. Baits that stayed on the animals without flaking off or leaching out in high humidity gave good control. Acceptable levels of toxicant must also be used in baits. Excessive amounts, such as 0.5 to 1.0 percent DDVP, are apt to be somewhat repellent to the face fly. A formulation containing 0.2 percent DDVP was optimum in acceptance.

Sugar or powdered sugar baits worked well for four to six hours, but they tended to dry out and flake off the animal.

Sirup baits made with high dextrose equivalent sirups gave inadequate control. Several commercial baits made with 68 percent DE sirup, when applied to the cattle at 5:00 a.m., leached out rapidly as this formulation readily absorbed the moisture in the air. Little killing action was observed after 8 to 10 a.m. These formulations reduced the population 65 to 75 percent. When low DE sirup baits (36 to 42 percent DE) were used, leaching was not a problem and baits continued to kill rapidly throughout the day. With 0.2 percent DDVP in 42 percent DE corn sirup, we reduced the average number of face flies to one or two flies per cow by the end of the first week of baiting.

In one of our experimental treatments of University animals, we baited daily for two weeks and then discontinued the treatment. Observations 10 and 14 days after treatment indicated that the bait was still active, although the population had risen to three or four face flies per cow.

WEED CONTROL IN CORN, PRE- AND POST-EMERGENCE

F. W. Slife

Weeds in cornfields reduce corn yields. On some farms they can have the most important effect on yields, while on others they may not be any more important than insects, low soil fertility, or other factors that limit corn yields. On a few farms, they cause little problem because of good management practices followed in the past. With many new control measures now available, the farmer can hardly overlook control of weeds if he expects to get maximum corn yields.

It is important to remember that cultural practices affect weeds as well as crops. Time of planting and method of cultivation will encourage or hinder our weed population. In most years late-planted corn is much less weedy than early-planted corn, because early planting comes at the time weeds are germinating, while delayed planting lets many of the weed seeds germinate and hence they can be destroyed by seedbed preparation.

At one time most of the corn in the Corn Belt was planted in hills so that it could be cross-cultivated. Recent figures indicate that in Illinois about 90 percent of our corn is now hill-dropped or drilled. There is no question about the convenience of hill-dropping and drilling compared with planting corn in hills. But with this convenience we increase the opportunity for weeds to grow in the corn row.

There is little likelihood that we will return to delayed planting and cross-cultivation to control weeds in corn. On the contrary, we are going in the other direction. But since we generally plant early unless rains interfere, and since we hill-drop and drill such a high percentage of corn, weeds are becoming a problem in fields, and it would appear that the use of chemical control should increase greatly in the future.

There are a number of good herbicides for controlling weeds in corn, and new ones are likely to be found that will be even more effective. The farmer should not base his choice on the sales pitch of a good salesman, but on the kind of weed problem he has. A serious weed problem does not appear in one year, but is the result of many years of weed seeds falling on the soil. He should first determine whether the problem is grass or broadleaf weeds or a combination of both. If he has only broadleaf weeds, then there will be little or no need to use pre-emergence herbicides. 2,4-D as a post-emergence spray has been highly effective against the common broadleaf weeds found in cornfields and has given more consistent results than pre-emergence sprays.

Although 2,4-D has come into standard use in many areas, it has some drawbacks. Each year some cornfields are injured either by overdosage or by misapplication. With the increased use of 2,4-D, injury to nearby susceptible crops has increased. The result has been legislation restricting the use of 2,4-D, and continuance of widespread damage can only mean more legislation. Only the amine formulation should be used in areas where sensitive crops are grown, and even it should not be used in fields adjoining sensitive crops. Although 2,4-D is best to use for broadleaf weeds in corn, pre-emergence chemicals would be justified in fields adjacent to sensitive crops, even if the problem is only broadleaves.

Pre-emergence sprays have become popular within the past three or four years. In total acreage treated, they do not compare with 2,4-D post-emergence, although the pre-emergence-treated acreage is increasing rapidly. There are many reasons why pre-emergence weed control is attractive, but the major reason for its use in cornfields should be to control grass weeds. Grass weeds in corn are increasing rapidly, and it would appear that our major problem in the next 10 to 20 years will be primarily grass rather than broadleaf weeds. The three most widely used pre-emergence treatments for corn are 2,4-D, Atrazine, and Randox. Each has different characteristics. Before making a choice, the farmer should be familiar with these characteristics so that he can pick the one that will most nearly fit his needs.

2,4-D

The most widely used pre-emergence treatment for the past few years has been 2,4-D. It costs least, is easy to handle, and has been widely available. Unfortunately, germinating corn does not have a high degree of tolerance to 2,4-D, and the chemical may injure the corn if enough rain occurs to move the material down to the germinating level. With average rainfall, injury has not been a major factor; but in such years as 1960, when heavy rain falls, it becomes more widespread and serious damage may occur.

In addition to causing possible injury to the crop, 2,4-D does not control grass so well as the broadleaf weeds. If rains occur within a few days to one week after application,it will frequently control grass weeds; otherwise, the germinating grass weeds will not be affected. 2,4-D controls germinating broadleaf weeds very well, but that is not the primary purpose of using pre-emergence chemicals in corn.

Both Atrazine and Randox control grass weeds better in corn than 2,4-D does; in addition, corn is highly tolerant to these compounds. For these reasons it seems logical that 2,4-D pre-emergence will be less important in the future in cornfields than it has been in the past.

Atrazine

Although Atrazine is relatively new in the pre-emergence field, it has been highly successful. It controls both grasses and broadleaf weeds, and corn is highly tolerant to it. Its long soil residue will control weeds all season long but will prevent seeding of winter grains the same season. Atrazine is only slightly soluble in water,and therefore a good rain is needed to make it effective. Its effect is not destroyed, however, by heavy rain (two or more inches), and under these conditions it is probably the best pre-emergence chemical to use for corn.

Randox

Randox has been available for controlling grass in corn since 1956, but it does not control the broadleaf weeds. Randox is irritating to handle, but this problem is not insurmountable if adequate precautions are taken, such as wearing goggles and rubber gloves. Since Randox is slightly more soluble than Atrazine, it requires less rain to make it work, but very heavy rainfall may dilute it to the extent that weed control will not be perfect. Randox should not be used on sandy soils, as it leaches too easily.

As Randox and Atrazine are used more widely, more information will become available on what particular areas they work best in. For example, Randox performs poorly on sandy or light-textured soils, but Atrazine is extremely good under these conditions. On the other hand, where soils are high in clay and very high in organic matter, Randox seems to work well, but the normal rates of Atrazine are not sufficient to give consistently good results. With further experience I am sure that there will be some variation in recommended rates and areas of use for these compounds.

The newest area in pre-emergence chemicals is granulars. Pre-emergence chemicals seem to perform about as well in granular as in liquid form, but only if the granulars are applied evenly so that a good pattern is obtained. Although both forms performed well in 1960, the granular forms were not quite so good as the liquid sprays in some instances. From the information that can be gleaned from the areas of use, the difference would appear to be due to poor application rather than to any defect in the granular form. Granular applicators are new; they have required a considerable amount of adjustment, and more is anticipated. It will undoubtedly be several years before the bugs are completely gone. Since the granular forms are convenient, however, and are rapidly being accepted by the farmer, we should make every effort to provide good granular equipment.

SEASONAL SEQUENCE OF NORTHERN CORN ROOTWORM ATTACK

J. W. Apple

Eggs of the northern corn rootworm, Diabrotica longicornis, are laid in the soil of cornfields during late summer and remain in this developmental stage until the following June or July. Should such a field be replanted to corn, the ensuing larvae seek out and feed upon the adventitious roots of the partly grown plants. Destruction of these roots deprives the plant of its major support, and lodging during July or August is the normal consequence.

Newly emerged rootworms are not readily found in the soil, but their presence can be detected in the youngest crown roots (underground adventitious roots). Root examinations in 1960 prior to July 5 failed to reveal rootworms, but on that date larvae were encountered at Arlington, Wisconsin, in the newly developed fourth set of crown roots. The three earlier sets of crown roots and the seminal root system had developed a corky outer surface and appeared to be unattractive to the rootworms.

Frequent root examinations between July 5 and August 11 showed that worms tended to be present in greatest number in the most recently developed crown roots. Such roots possess a fleshy cortex surrounding a central core consisting of the phloem and xylem. It was in the cortex that rootworms were found most frequently. As the root matures, the cortex is lost and the outer surface of the root becomes lignified. During the peak attack (7/8-7/22 in 1960), larvae invaded new crown roots which were only a few inches long, and excessive feeding resulted in destruction of terminal meristematic tissue which controls elongation as well as meristematic sites on the central core of the root from which laterals develop. The resulting roots were left as decaying stubs just below the ground surface. In our 1960 studies with a May 25-26 planting of corn, we found the fifth and sixth sets of crown roots showing this severe damage. Earlier planted corn might have the sixth, seventh, and possibly eighth (the last) set of crown roots with this severe symptom.

Adventitious roots arising from internodes above ground level are called brace roots. The first or second set of these may suffer some rootworm damage, but normally these roots appear after the major rootworm attack. Kiesselbach of Nebraska reports that roots making up the first five sets of crown roots grow horizonally as they leave the stalk, while the last three sets grow downward. These latter roots thus provide much bracing for the stalk even though they are below ground, and their partial or complete loss is the real reason for lodging. In view of these observations, we would be more correct to speak of plants lodging as a result of crown root damage rather than brace root destruction. Even though half or more of the functional roots may be destroyed by rootworms, the remaining roots provide enough nutrients for the plant to produce yields which are 80 percent or more of normal.

SOIL INSECTICIDE RESEARCH, PARTICULARLY WINTER APPLICATIONS

J. H. Bigger

Soil insecticide tests carried on in 1960 followed the same pattern as in recent years. We obtained our data on field plots of three to five acres each on land of cooperating farmers who in most cases left untreated areas for us in fields they were treating. We also had the cooperation of several farm advisers and five aerial applicators. There were 72 tests on 46 farms in 18 counties.

This past year we placed more stress on applications made prior to planting time. The insecticides were applied during the fall, winter and spring, and usually prior to plowing the field. Our data include information regarding times of application, disking, and plowing, as well as the kind, type, and amount of insecticide used.

Data for the 1960 season are given in the accompanying tables. The small number of fields in which some of the insects were found is traceable to delayed planting. It has long been known that this is a good way to avoid damage from many seed- and root-infesting insects of corn.

It appears that the pre-planting-time treatments fail to control cornfield ants and corn root aphids. Otherwise they appear to be on a par with planting-time broadcast treatment.

Plant population data indicate that the pre-planting-time treatments approach the effectiveness of broadcast treatments.

Yield data were secured from 25 tests. Two tests showed extreme differences such as are infrequently encountered. The records with these removed (figures in parentheses, Table 3) are more realistic than the actual data secured.

The tests with pre-planting-time treatments have progressed to where we can give qualified approval to applications of this type if they are made during the winter--considered for this purpose to be the period between December 1 and March 15 in central or northern Illinois. Applications made later in the spring should probably be treated like planting-time treatments and disked in promptly.

Table 1. Percent of Control of Certain Insects Obtained by Various Methods of Applying Soil Insecticides, 1960

(Numbers in parentheses are number of tests involved)

Insect involved	Type of treatment: Broadcast at planting time	Pre-planting by ground	Pre-planting by plane
Wireworm	(6) 80.0	(7) 75.0	(7) 100.0
White grub	(3) 76.2	(2) 100.0	(0) --
Cornfield ant	(4) 75.0	(9) 37.5	(5) 50.0
Corn root aphid	(3) 100.0	(8) 6.3	(4) 42.9
Corn rootworm	(5) 93.2	(6) 87.0	(10) 86.2
Colaspis	(4) 76.9[1/]	(0) --	(1) 100.0

1/ Low because of one unexplained failure.

Table 2. Plant Populations on Fields Where Soil Treatments Were Applied by Various Methods, 1960

(Numbers in parentheses are number of tests involved)

Category	Type of treatment: Broadcast at planting time	Pre-planting by ground	Pre-planting by plane
Number of plants per 500 feet	(16)	(10)	(20)
Treated area	499 1/	558 1/	517 1/
Untreated area	461 1/	528 1/	491 1/
Difference in favor of treatment			
Per acre	996	789	660
Percent	8.3	5.7	5.1

1/ These figures rounded off to whole numbers.

Table 3. Yields of No. 2 Corn Where Soil Treatments Were Applied by Various Methods, 1960

(Numbers in parentheses are number of tests involved)

	Type of treatment: Broadcast at planting time	Pre-planting by ground	Pre-planting by plane
Bushels No. 2 corn on:	(8)	(6) 1/	(9) 1/
Treated area	106.8	108.2 (112.0)	103.1 (104.7)
Untreated area	97.8	94.9 (104.0)	99.8 (98.5)
Difference favoring treatment			
Bushels/acre	9.0	13.3 (8.0)	3.4 (6.2)
Percent	9.2	14.0 (7.7)	3.4 (6.3)

1/ One extreme in each of these groups. Numbers in parentheses are data with extremes removed.

SIMAZINE AND ATRAZINE RESIDUES IN SOIL

O. Hale Fletchall

The triazines are a fairly new group of herbicides. The use of simazine and atrazine to control weeds in corn is increasing. It is possible that these chemicals, or perhaps one of them, will be widely used in corn production within the next several years.

Simazine and atrazine have three outstanding properties: (1) they control weeds for the entire season, (2) they are effective against almost all annual weeds that infest corn, and (3) at reasonable rates they do not injure corn.

The properties of long-lasting effect and activity against a broad spectrum of plants become disadvantages after the corn crop is produced. Some of the chemical is still in the soil when it is time to plant the crop that follows corn, and some crops can be injured by the amount that remains in the soil.

Simazine and atrazine are very similar chemically. Both have a very low solubility--simazine, 5 ppm., and atrazine, 70 ppm. They perform much alike as pre-emergence herbicides. Simazine is almost ineffective as a post-emergence herbicide, but atrazine will kill weeds 1 1/2 inches tall or larger.

Like most pre-emergence herbicides, simazine and atrazine are not fully effective under conditions of dry topsoil for a week or two after application. There is some evidence that atrazine, possibly because of its greater solubility, is slightly more active than simazine under these dry conditions.

It has also been speculated that atrazine, with its slightly greater solubility, would have a shorter period of soil residue effect and thus be safer than simazine for crops following treated corn. This is reasonable, but in experiments conducted at the Missouri Agricultural Experiment Station atrazine has been no less toxic to crops than simazine in the year following application.

Research and field observations indicate that it is safe to follow a simazine- or atrazine-treated corn crop with corn, sorghum, soybeans, or cotton. There is some hazard to winter wheat and spring oats following a treated corn crop. Research is still in progress to determine the effect of simazine or atrazine residues in the soil on the various forage crops that might be seeded the spring following application.

CONTROL OF QUACKGRASS AND WIRESTEM MUHLY WITH ATRAZINE

W. O. Scott

Quackgrass and wirestem muhly are similar in that both are perennials and reproduced by seeds and rhizomes. This is about the extent of the similarity. Quackgrass is a "summer grass," setting seed in June and July. Wirestem muhly, on the other hand, is a "fall grass," setting seed in September and October. Obviously the growth habits of a summer and a fall grass are quite different. The summer grass starts growth early in the spring, while the fall grass starts later in the spring. In the fall the summer grass is in a vegetative stage, growing relatively vigorously when the fall grass is putting all its effort into producing seed. This difference may help to explain why some of the methods used to control quackgrass do not work so well with wirestem muhly. We hope, however, that Atrazine used as it would be to control quackgrass will give practical control of wirestem. There is some evidence that a pre-plant treatment with Atrazine will be successful with wirestem. This method of using Atrazine has not received F.D.A. approval, but it is hoped that such approval will be obtained.

Four pounds of Atrazine (active ingredient) applied to quackgrass in the fall before growth stops has given excellent control. The treated area is left undisturbed in the fall and winter and is plowed in the spring. This method of using Atrazine has received F.D.A. approval for corn production, and the results have been excellent.

Equally effective is an early spring pre-plant application of 2 1/2 pounds of Atrazine before plowing. This method does not have F.D.A. approval and is not recommended in Illinois.

When you sell a fall Atrazine treatment for quackgrass, don't leave the job half done. Sell pre-emergence control for the new quackgrass seedlings that will attempt to establish themselves from seed that is in the soil.

CHEMICAL CONTROL OF AQUATIC WEEDS

Robert C. Hiltibran

Chemical control of aquatic weeds can be divided into three areas: (1) recognizing the aquatic plant, (2) estimating the water volume to determine the necessary amount of chemical preparation to apply, and (3) selecting the appropriate preparation. To assist in these areas, the following information is presented.

Identification of the aquatic vegetation by species is not required, but it is necessary to make certain distinctions between the large number of aquatic species. The aquatic plants are grouped according to their distribution in water. The following grouping will assist you in arriving at a suitable control if available.

Group I--Free-floating-plants. An example is duckweed (*Lemma minor*), a small plant consisting of two leaves about 2 to 3 mm. in diameter with two or more small roots extending in the water.

Group II--Emergent plants. Plants of this group are rooted in the bottom, and the leaves and stems extend through the water. Two examples are cattail and water willow. These usually do not grow in water more than three or four feet deep.

Group III--Submerged plants. Members of this type represent the more troublesome species and are divided into two groups because of the distinction between members that is necessary to obtain satisfactory control. Two examples are water milfoil (*Myriophyllum spp.*), which has a very delicate leaf resembling the ancient musical instrument, the lyre, and coontail (*Certophyllum demersum*), which has a row of small barbs on the leaf that have a bushy appearance resembling the tail of a coon. Frequently, however, the name coontail is applied to the milfoil group.

Group IV--Submerged Potamogeton plants. The plants that constitute this group have a variety of leaf forms that makes their identification difficult, but they can be distinguished from Group III by their leaf structure. Most of the common plants can be controlled with sodium arsenite, except sago pondweed (*P. pectinatus*), which can be recognized by the many-branched stems and large number of threadlike leaves that float in fan-like fashion in the water. It is necessary to be able to distinguish between members of this group to decide control measures.

Group V--Floating leaf. The main characteristic is the leaves floating on the water. Examples are the water lily and floating-leaved Potamogeton, such as *P. natans* and *P. americanus*. This group does occur frequently but received some attention during 1960.

Applications in pounds per acre or pounds per gallon are satisfactory for the free-floating, emergent, and floating-leafed groups indicated above, as the herbicide preparation will be either applied to the water surface or to the foliage. Such rates are not satisfactory for the submerged group, however, as they do not take water volume into account. The rate that will be used is expressed in parts per million, that is, pounds of active ingredient per million pounds of water. To determine the amount of preparation, it is necessary to estimate the water volume, expressed as pounds. To determine the amount of water, only two things need to be known: the total area in square feet and the average depth of the water. The total area can be expressed in square feet, or surface acres.

Construction maps of ponds built under the various government programs will be helpful, or, if a partial area is to be treated, actually measuring the area will suffice. To estimate the average depth, the construction maps will be of assistance, or two series of measurements of the water depth, one lengthwise to the area to be treated and the second across the width of the water, obtaining the average from the depth measurements. Having these data, it is only necessary to put the information together in the following formula:

Area (sq. ft.) x Av. depth (ft.) x 62.5 (lb.) = pounds of water (one cubic foot of water weighs 62.5 pounds)

From the above formula you can see that the relationship between the surface area if in acres (43,560 sq. ft.) and the depth is such that one surface acre with an average depth of one foot contains approximately 2,700,000 pounds of water. An application of 1 ppm. will require 2.7 pounds of active ingredient.

Because of the large number of trade names which are available, with different rates of composition and various esters, etc., the rates of application which have been found to be effective on the members of the above-mentioned groups of aquatic plants will be expressed on the basis of the active ingredient, which in the case of 2,4-D, 2,4,5-T, and 2,4,5-TP will be expressed on the free acid equivalent and will be stated on the other preparations as they become available.

Two types of preparations are available, liquid and granular formulations. While it is anticipated that one type of formulation should be equally as effective as the other so long as the dosage rate is the same, such comparisons have not always been made, so the suggested rates of application will also indicate which types of preparations have been found to be effective. Caution--<u>BE SURE TO READ THE LABEL CAREFULLY</u>.

To determine the chemical preparation, the following table is given for convenience. Many of the chemical preparations are toxic to fish and livestock and flavor milk and fish products. But, when used according to the rate below or as given on the label, these preparations are safe to use <u>if the directions are followed carefully</u>. Also, use only those chemical preparations that are recommended for the weeds you desire to control. Observe the necessary time interval in the water use.

Group and species	Chemical	Rate of application	Remarks
Emergent			
Water willow	2,4-D(20%G)[2]	1 lb./430 sq.ft.	Spread on water
<u>Dianthera</u> <u>spp</u>.[1]	2,4,5-T (L)[2]	1 cup/gal. water	Wet foliage thoroughly
	2,4,5-TP (L)	" " " "	" " "
Water primrose,	2,4-D(20%G)	1 lb./430 sq.ft.	Spread on water
<u>Jussiaea</u> <u>spp</u>.	2,4,5-T (L)	1 cup/gal. water	Wet foliage thoroughly
	2,4,5-TP (L)	" " " "	" " "

Group and species	Chemical	Rate of application	Remarks
Arrowhead, Sagittaria spp.	2,4-D(20%G)	1 lb./430 sq.ft.	Spread on water
	2,4,5-T (L)	1 cup/gal. water	Wet foliage thoroughly
	2,4,5-TP (L)	" " " "	" " "
Cattails, Typha spp.	Dalapon3/	4 oz./gal. water and 3 caps detergent	" " "
	Amino triazole	2 oz./gal. water and 3 caps det./gal.	" " "
Submerged			
Coontail, Ceratophyllum spp.	2,4-D(20%G)	3 ppm.	Spread on water
	2,4,5-T (L)	3 ppm.	Apply below water
	2,4,5-TP (L)	3 ppm.	" " "
	Endothal (G)	5 ppm.	Spread on water
	Sodium arsenite	5-10 ppm.	Apply below water
Water milfoil, Myriophyllum spp.	2,4-D (G)	3-4 ppm.	Spread on water
	2,4,5-TP (L)	2-3 ppm.	Apply below water
	Endothal (G)	3 ppm.	" " "
	Sodium arsenite	5-10 ppm.	" " "
Submerged Potamogeton			
Sago pondweed, Potamogeton pectinatus	Endothal (G)	1 ppm.	Spread on water
Curly-leaved pondweed, Potamogeton crispus	Endothal (G)	1 ppm.	Spread on water
	Sodium arsenite	8-10 ppm.	Apply below water
Fine-leaved pondweeds, P. spp.	Endothal (G)	1 ppm.	Spread on water
	Sodium arsenite	5-10 ppm.	Apply below water
Floating-leaved pondweeds (Potamogeton spp.)	Endothal (L)	1 cup/gal. water	Spray leaves on surface

1/ Scientific names are those of Fasset (revised).
2/ L = liquid form, G = granular form.
3/ Dalapon is the common name for 2,2-dichloropropionic acid.

During 1960 endothal was approved for aquatic weed control and will be distributed under the trade name Aquathol. The active ingredient is disodium salt of endoxohexahydrophthalic acid, the suggested rate of application is based on the salt. This preparation has been effective on the sago pondweed (P. pectinatus).

At the session pictures will be shown of the various aquatic weeds, and the main characteristics and differences will be discussed. During the sessions some time will be devoted to the discussion of the use of Aqualin, a product of the Shell Chemical Company in a drainage ditch this past summer.

HOW TO PREVENT CORN LEAF APHID DAMAGE

C. A. Triplehorn

Since 1957 the corn leaf aphid has been the corn pest of primary concern to growers in northwestern Ohio, and during this period we have been able to make a number of interesting and valuable observations. We have even gained enough confidence to publish an information sheet under the above auspicious title (see accompanying sheet).

The corn leaf aphid problem is one of many facets. The insect is most unpredictable in its arrival, buildup, persistence, and ultimate disappearance from cornfields. It is present every year, but usually not in sufficient numbers to cause alarm. Nevertheless, it is a potential pest of considerable magnitude, and its activity should be closely observed every year to avoid the disastrous results experienced in Ohio in 1957 and 1959. We believe that in the accompanying sheet we have provided our growers with the most up-to-date consideration of the problem and that we will be vastly better prepared should the insect attain econmically important proportions again, which it undoubtedly will. The following discussion is designed to clarify the underlying reasons behind our current recommendations:

Resistant Hybrids. The fact that certain genetic strains of field corn demonstrate varying degrees of resistance to corn leaf aphid attack has been recognized for a long time--even before the advent of the European corn borer. By a fortunate coincidence, the same inbred lines that are aphid-resistant are also corn borer-resistant to a closely parallel degree. The Ohio corn breeders have been collecting data on corn leaf aphid along with stalk rot, leaf blight, and corn borer for many years and incorporating the genes responsible for resistance into many of the Ohio hybrids.

Without delving deeper into the genetics of the corn breeding program, it is sufficient to state that throughout the four years' observations the four Ohio hybrids listed in our recommendations have been outstandingly consistent in escaping severe aphid infestation with its attendant damage. The performance of these hybrids under the severest aphid infestations has been dramatic indeed, especially when they could be observed growing in the same fields with other less resistant hybrids. If we were able to anticipate a year in which aphids would be a serious problem, there is no question but that resistant hybrids would be our number one recommendation.

Planting Date: Not enough information is available for us to recommend the manipulation of planting date for corn leaf aphid control, but it is a fact that stage of plant growth, which in turn may be influenced by planting date, is an important factor in determining whether or not a plant will become infested. Observations consistent at least over the past four years indicate that the very early and very late plantings in a particular area largely escaped aphid damage, possibly for two entirely different reasons. The early plantings were well enough advanced, usually tasseled and pollinated before the earliest aphids arrived. For some reason aphids are apparently not able to become established well on plants at this stage of growth, or perhaps such plants are not attractive to them. Reasons for the escape of the late plantings are not clear. Seemingly, once aphids arrive, they would continue to infest corn as it came into the attractive stage. But such was not the case, at least from 1957 through 1960.

Effect of Weather: Severest aphid damage appears to be associated with hot, dry seasons. Many times it is difficult to distinguish damage caused by drought from that caused by aphids. Experiments conducted in 1958 indicate that, when soil moisture is adequate, the effect of aphid feeding on corn plants is minimized. This is not to say that under moist conditions aphids do not affect yields, but several good rains at the right time will, in most cases, reduce damage to a level where a grower should think twice before investing in spray applications.

Insecticides: If used properly, both malathion and parathion are quite effective in reducing aphid populations. This means getting the insecticides into the whorl of the plant at or just prior to tassel emergence. Spectacular aphid kills have been reported with airplane applications of these two materials after tassel emergence, but this was thought to be too late for much benefit in most instances.

Preliminary studies have been conducted on granular formulations of insecticides which performed well as sprays. Good to execellent results have been obtained, and most of our recent work has been based on granulars. Phorate (Thimet) and Di-Syston granules were outstandingly effective in giving nearly complete control in less than twenty-four hours when applied as tassels were emerging. In 1960 phorate was granted an experimental label for use only on seed corn at the rate of 10 pounds of 10 percent granules (1 pound actual) per acre. Unfortunately, the infestation we were expecting never materialized, and most of the seed fields we had scheduled for treatment were not used. One airplane application of phorate granules was made but, as in the other cases, infestations were so light that results were inconclusive.

Among the many answers we would like to obtain is the important consideration of how much we can expect to increase corn yields by controlling corn leaf aphids under a variety of conditions. Until we are certain that growers will receive a reasonable return for their investment, we are not promoting insecticide applications.

How to Prevent Corn Leaf Aphid Damage

Aphids cause damage while corn is still in the whorl stage. They feed inside the whorl, protected from both weather and insecticides. It is not until the whorl opens to let the tassel grow out that aphids are often discovered.

There are two ways that damage may be prevented, but one method is much more reliable than the other. Ohio recommends the use of aphid-resistant hybrids as being better than the use of available insecticides.

Corn Leaf Aphid Resistant Hybrids: The best protection against aphid is in the seed corn bag. Many years ago selection began for plants that were resistant to borer and corn leaf aphid. Several strains with strong stalks and good root systems were selected as parents for hybrids that are now resistant to the corn leaf aphid and the European corn borer. The aphid-resistant varieties are K62 and W64, each with three aphid-resistant parents; C54 contains two resistant strains, and AES 805 has one. The performance of all four varieties was outstanding in 1959. When these varieties were planted next to hybrids with no resistance to aphid, the difference in infestation was easy to see. K62, W64, C54, and AES 805 can be made to husk clean by proper adjustment of the corn picker. This has been a matter of experience on commercial acreages. The use of picker-shellers also overcomes any objection there might be to these tight-husked but aphid-resistant hybrids.

Insecticide Control: Malathion or parathion will destroy aphids, but they do not prevent damage unless applied when tassels are 25-50 percent out. High-clearance ground sprayers are preferred equipment. The results with airplane application have not been consistent, but this method should not be ruled out. Since high-clearance ground sprayers are not common equipment and there are only a very few days when insecticide can be used with benefit, insecticide applications are not as reliable as resistant varieties.

If it is necessary to use an insecticide, use:

Malathion, 1 pound actual per acre (1 quart 57% EC)

or

Parathion, ½ pound actual per acre (1 pint 50% EC) in about 25 gallons of water for ground equipment (4 gallons for airplane)

Spray only if:

1) 25% of the plants are heavily infested, and when
2) tassels are 25-50% out (within one or two days after infestation appears) and if
3) soil moisture is low

Prepared by
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February 1960

THE CORN LEAF APHID AND ITS EFFECT ON LOSSES OF YIELD OF DENT CORN

Ray T. Everly

The corn leaf aphid, Rhopalosiphum maidis (Fitch), was first recognized as a pest of corn by Fitch in 1856. This insect was confused with the corn root aphid until 1884, when Forbes determined them to be two different species. Early reports of injury by this insect were restricted to symptomatic expression of injury to individual plants and were not associated with reduction in yields.

Characteristic symptoms of injury by the corn leaf aphid range from presence of cast skins and isolated colonies in light infestations to a "blight-like" destruction of the tassel and upper leaves of severely infested plants. In 1921, McColloch reported seven types of injury to corn: (1) injury to the central spike of the tassel, resulting in failure to produce pollen; (2) gumming up of the lateral spikes with honeydew secretions which prevent pollen shedding; (3) failure of tassels to emerge; (4) molds and rots developing in the upper portion of the corn plant and often extending down to the ears; (5) corn leaves turning yellow and red and often dying; (6) aphids feeding on the silks and kernels and hastening maturity, with ears only partially filled; and (7) abundance of honeydew, which attracts adults of the corn earworm and often results in increased infestations of this insect.

The work of Snelling, Blanchard, and Bigger in 1940 was the first report of barrenness produced by the feeding of this insect. They stated that it was due to a physiological reaction of the plant rather than to lack of pollination. Bigger, in 1958, reported the first quantitative effect of the aphid on corn yields by showing the percent of increase in barrenness associated with aphid infestation. Triplehorn, in 1958 and 1959, gave data showing weight reduction in ears and percent of loss in yield of corn for varying degrees of aphid infestation.

The corn leaf aphid has been a pest of corn for many years, but has received particular notice only occasionally when the infestation has been severe enough to attract attention. Neiswander, in 1948, observed that the insect had become increasingly abundant in the past 15 to 20 years. In Indiana, infestations of corn by this insect reached a peak in 1959. In 1958, calls by growers from northeast Indiana indicated quite severe infestations locally that may have been indicative of the severe infestation that occurred the following year.

Evaluation of Damage. Until we can develop techniques for obtaining varying degrees of infestation in plot studies, field evaluation of loss of corn yield under heavy infestations by the corn leaf aphid is the only method available for estimating the importance of this insect. Such field studies have certain inherent limitations based upon the ecology of the insect and its behavior patterns, about which we have little information.

To obtain our preliminary estimates of loss, two methods were used. In one case the methods of Bigger and Triplehorn of tagging individual plants in heavily infested fields were used. In the second case, the cornfields used in our annual fall corn insect survey were studied. In these fields, the plant samples used for evaluating corn earworm and European corn borer losses were also used to measure the corn leaf aphid infestation and losses. Plants in the sample were separated into non-infested, lightly infested, and severely infested classes. Within each class were recorded the barren plants and plants with nubbins. The data from the uninfested class were then used to measure the increase in nubbins and barren plants associated with the intensity of the aphid infestation. The total loss was corrected for the percentage of lightly and heavily infested plants in the sample.

Individual Field Studies. A field of corn near Portland, Indiana, was used for this study. Sixty-one percent of the corn plants were infested, with approximately 31 percent showing severe infestations. In July, at the time the tassels were about 90 percent exposed, 251 consecutive plants were tagged. Of these, 99 plants showed no apparent aphid infestation at that time, 75 showed isolated small colonies in the tassel or individuals on the leaves, and 77 showed severe infestation, i.e., a solid mass of aphids, often with necrotic areas on the tassel and upper leaves, frequently extending down to the ear zone. A black, sooty mold was also generally present. These plants were harvested on October 10, and yields from the three classes were kept separate. Table 1 gives the data from this field.

Table 1. Yields of Corn From Plants With Varying Degrees of Infestation by the Corn Leaf Aphid, Portland, Indiana, 1959

		Class of infestation 1/			Total
		None	Light	Severe	sample
Plants in each class	Number	99	75	77	251
	Percent	39.4	29.9	30.7	100
Ears					
Harvested	Number	102	76	43	221
Cobs barren	Number	0	0	16	16
Plants without ears	Number	0	0	18	18
Plants producing no seed	Percent	0	0	44.2	13.6
Yields					
Weight of ears	Pounds	54.8	37.7	19.8	112.3
Weight of yield per plant	Pounds	.55	.50	.26	.44
Weight per ear	Pounds	.54	.50	.46	.51
Yield per acre	Bushels	72	65	34	57
Loss of total yield	Percent	0	3	17.8	20.8
Reduction in yield within each class of infested plants	Percent	0	10	53.2	0
Plants producing two ears	Number	3	1	0	4

1/ Classes of infestation defined as:
None - no aphids present.
Light - small colonies or individual aphids scattered over plants.
Severe - tassels dwarfed, heavy masses of aphids on tassels and upper leaves, presence of sooty mold growing in honeydew secretions on upper leaves, upper leaves showing a blighted condition, often extending down to the ear zone.

Classification of the infestations on the plants was made July 30. Harvest was made October 10 from plants tagged on July 30.

The ears per plant did not differ significantly in the non- and lightly-infested classes of plants. However, in the severely-infested class 23 percent of the plants were barren (produced no ear), and an additional 21 percent produced a completely developed ear which set no seed. Thus in this class 44 percent of the plants produced no yield. Based on total plants in the sample, this represents a loss of 13.6 percent from non-production of seed.

In addition, another type of loss occurred. This was shown in the reduction in average weight per ear. Based on the plants in each plant class that produced seed-bearing ears, the average weight per ear was .54, .50, and .46 in the non-, lightly-, and severely-infested plants, respectively. This represents a loss of 7 bushels and 14 bushels per acre from reduction in ear size and weight for the light- and severely-infested plants. Total loss in this field, based on reduction in ear weight and barren plants, was 20.8 percent. Using the non-infested plants as a check, this represents a 10 percent loss from the lightly-infested plants and a 53.2 percent loss from the severely-infested plants. The important information from these data is the 10 percent loss in yield among the lightly-infested plants. Heretofore, we have associated the loss in yield from this insect almost entirely with the increase in barren plants and have assumed that light infestations were of little importance. These data would indicate that light infestations of the corn leaf aphid may be causing losses of economic importance.

Near Bourbon, Indiana, a 40-acre field containing seven commercial double-cross hybrids was heavily infested with the corn leaf aphid. These hybrids were planted in strips 14 to 20 rows wide the length of the field. Fifty plants were examined in each end of the central row of these hybrids, and the severely-infested plants, plants with nubbins, and plants with no ears were recorded. Every plant examined was infested with aphids, so that only two classes of plants were present. These data are given in Table 2.

Table 2. Infestation and Losses to Commercial Dent Corn Hybrids From Infestations of the Corn Leaf Aphid, Bourbon, Indiana, 1959

Variety	Severely infested plants[1/]	Plants with no ears	Plants with nubbins	Total loss
	%	%	%	%
Crow 432	47	7	18	16
DeKalb 423 (a)	32	14	12	20
(b)	38	18	12	24
Crib Filler 166G	39	9	25	22
Indiana 610	26	21	14	28
Crib Filler 151G	60	29	30	44
DeKalb 411	45	23	28	47
Crib Filler 163G	68	34	33	50
Averages	45	19	22	30

1/ All varieties were 100 percent infested. The data in this column represent the percent of plants showing severe infestation--stunted tassels, upper leaves dead and discolored with sooty mold, and massive areas of cast skins.

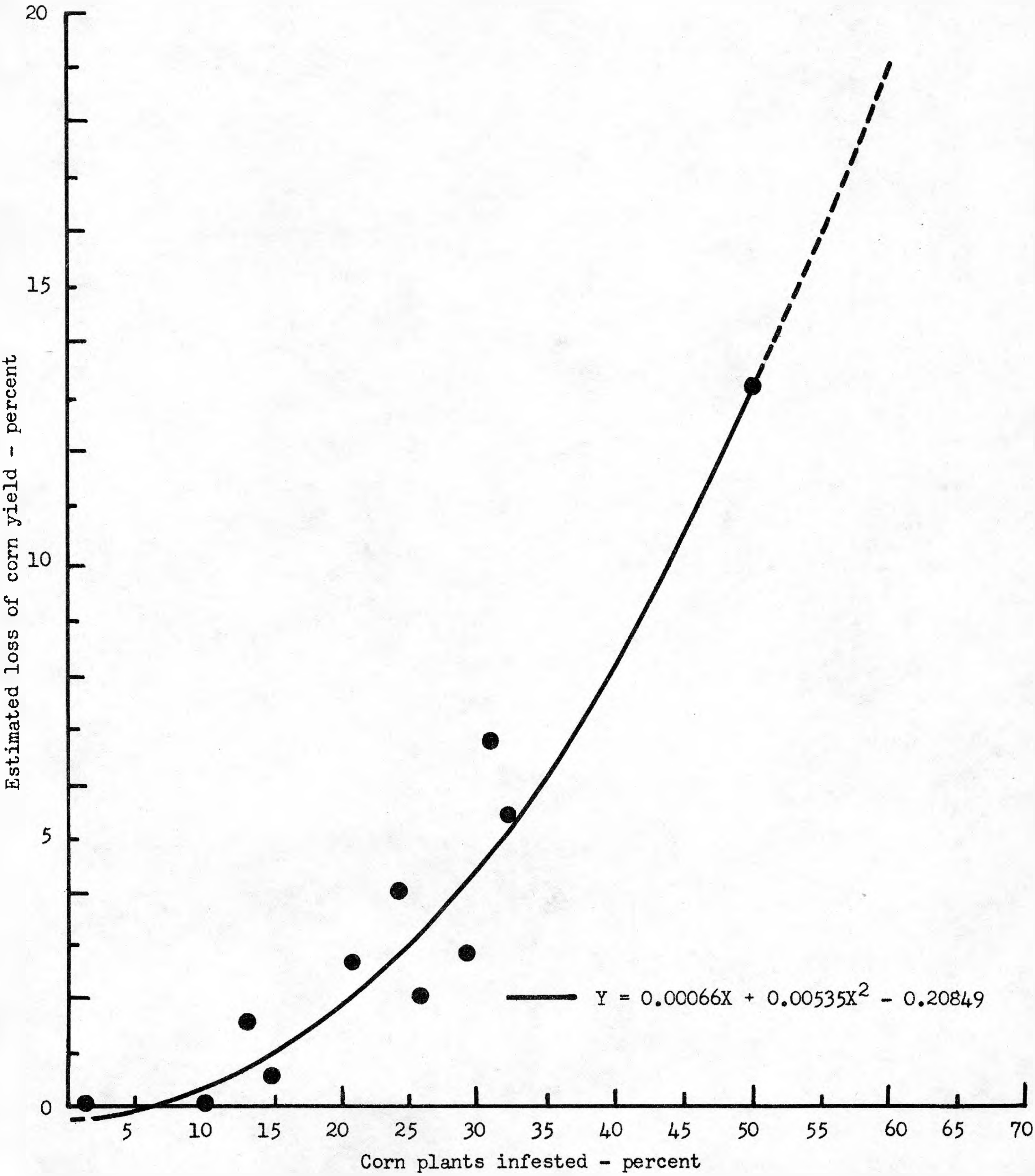
Estimates of loss in yield were based on a 50 percent reduction for those plants with nubbin ears and a 100 percent loss for those that were barren. The Crow hybrid 432 had about average infestation but was lowest in estimated loss of yield, indicating considerable tolerance to the attack of this insect. On the other hand, DeKalb 45 showed low tolerance with about average infestation and was second highest in loss of yield. Indiana 610 had the lowest infestation but was about average in loss of yield, indicating some resistance to the aphid but rather high susceptibility to loss. It should be pointed out that these data are observational and, although these hybrids were all planted within a period of two or three days, nothing is known of the stage of growth or maturity at the time the aphid infestation occurred. However, it does indicate that there is a wide range of resistance to the development of this insect as well as considerable difference in yield tolerances to infestations by this insect. Since early infestations by the corn leaf aphid are difficult to detect, breeding for resistance and tolerance may be our most valuable approach to control of infestations of this insect and losses in corn yield.

Regional Losses in Corn Yield. The infestation and estimated percent of loss in yield due to the corn leaf aphid for the 12 survey areas in Indiana are given in Table 3. It will be noted that the southern fourth of the state was free from any measurable losses in yield. The areas of heaviest infestation and loss in yield were the north northeastern, northeastern, and north central. It will also be noted that there was a positive correlation between the total percent of plants infested and the total estimated loss. When these data are analyzed, there is a highly significant correlation and the percent of plants infested accounted for 85 percent of the variation in loss in yield. A graph of these data is given in Figure 1.

Table 3. Infestation by the Corn Leaf Aphid and Losses in Corn Yield in the 12 Survey Areas of Indiana, 1959

Area	Counties	Fields	Plants infested			Loss due to:		
			Light	Heavy	Total	Nubbins	Barrenness	Total
	No.	No.	%	%	%	%	%	%
NNW	7	16	10.8	4.0	14.8	.3	.2	.5
NNC	5	9	15.6	10.2	25.8	.8	1.2	2.0
NNE	6	10	28.4	3.6	32.0	3.5	1.8	5.3
NW	6	15	23.5	5.6	29.1	2.2	.5	2.7
NC	7	14	28.0	23.4	51.4	8.4	5.5	13.9
NE	10	19	19.4	11.3	30.7	4.5	2.1	6.7
SW	8	13	12.9	7.4	20.3	2.3	.3	2.6
SC	7	11	15.3	8.7	22.0	2.5	1.3	3.8
SE	9	16	10.2	4.0	14.2	1.1	.2	1.3
SSW	10	17	8.0	.9	8.9	0	0	0
SSC	8	10	1.2	0	1.2	0	0	0
SSE	8	10	8.0	.4	8.4	0	0	0
NN	18	35	18.3	6.1	24.4	1.5	1.0	2.5
N	23	48	23.6	13.5	37.1	5.0	2.7	7.7
S	24	40	12.8	6.7	19.5	2.0	.6	2.6
SS	26	37	5.7	.4	6.1	0	0	0
West	31	61	13.8	4.6	18.4	1.2	.2	1.4
Central	27	44	15.0	10.6	25.6	3.0	2.0	5.0
East	33	55	16.5	4.8	21.3	2.3	1.0	3.3
State	91	134	15.1	6.7	21.8	2.1	1.1	3.2

Figure 1. Losses in yield of dent corn and infestations by the corn leaf aphid. Indiana Fall Corn Insect Survey, 1959.



The fact that this relationship is definitely curvilinear suggests several interesting conclusions. Below certain levels of infestation, few or no heavily infested plants occur. This may be due to unfavorable environmental conditions which may inhibit colony development, or the migrating population of aphids was few in numbers and was distributed over a greater number of plants. In addition, as the percent of plants increases, the loss gradient becomes steeper. This is supported by the fact that, as the general level of infestation increases, the proportion of heavily infested plants tends to increase, and it is from these heavily infested plants that the greatest loss in yield occurs.

If we use the curvilinear equation for percent of plants infested and loss in yield to estimate the expected amount of loss in the field near Portland, Indiana (Table 1), we find that it should be approximately 19.5 percent. This compares very closely with that actually recorded, 20.8 percent.

The percent of plants heavily infested is also highly correlated with the total percent of plants infested. This relationship is also curvilinear and similar to that for percent of plants infested and loss in yield. Using this formula, we find that the proportion of plants heavily infested when 100 percent of the corn plants are infested is 44.5 percent. In the field near Bourbon, Indiana, containing the commercial hybrids with 100 percent of the plants infested, the average was 45 percent of plants heavily infested. However, when 100 percent of the plants are infested, the proportion of heavily-infested plants can continue to increase until it reaches a maximum of 100 percent. This permits a wide diversity in percent of heavily infested plants as the proportion of infested plants approaches 100 percent, so that the total estimated losses will vary more and more as the total percent of infested plants increases.

The use of the heavily-infested plants to estimate the loss in yield does not show as close a relationship as the total percent of infested plants. This may be explained by the fact that the lightly-infested plants which are included in the total percent of infested plants contribute a portion of this loss, which becomes proportionally greater as the number of heavily-infested plants decrease.

Conclusions. These data and interpretations are not intended to be the final answer to the loss in corn yields due to corn leaf aphid infestations. However, they are an approach to obtaining some approximation of the losses caused by this insect. It is also apparent that these losses are sufficient to make worth while extended research in the control of this insect. At the present time, because of the difficulty of discovering incipient outbreaks, the evaluation of current hybrid corn and inbred lines for both antibiosis and tolerance will be the most worth-while approach. It is also evident that we need information on the effectiveness of a spray program applied at the time most of the tassels have emerged. Aphid control is practicable at this time, but benefits may be limited, as ear development on heavily-infested plants may already be inhibited. It is here that the corn producer, in cooperation with the applicator, can contribute a great deal to our understanding of this aphid by leaving control strips when fields are treated. He should notify the entomologists in his state who are working on this insect, as they need to know the degree of infestation so that they can properly evaluate the results when yields are taken.

Reference. Everly, Ray T. 1960. Loss in Corn Yield Associated With the Abundance of the Corn Leaf Aphid in Indiana. Jour. Econ. Ent. Vol. 53(5):924-932.

CORN LEAF APHIDS - 1960

J. H. Bigger

Corn leaf aphid was looked at under three sets of conditions in Illinois during 1960.

1. Near Sibley we treated by hand where it was estimated than at infestation was starting on about 90 percent of the plants. Granules of Thimet (phorate) and a spray of Dimethoate were each applied at the rate of 1 pound technical per acre to plants in both whorl and tassel condition on August 11. These were checked on August 15 and classified as having the aphids "mostly alive" or "mostly dead."

Table 1. Percent of Plants With Corn Leaf Aphids "Mostly Dead" on Hand-Treated Plots at Sibley, 1960.

	Percent of plants with aphids "mostly dead"	
Treatment	Treated in whorl	Treated in tassel
Thimet granules	92.7	98.0
Dimethoate spray	7.5	98.0
Untreated	4.0	4.0

Thimet granules gave excellent control in both whorl and tassel. Dimethoate spray did not control the aphids in the whorl but did control those in the tassel (Table 1). Parasites and predators cleaned up the infestation shortly after these observations. No barren plants due to aphid attack developed in the field.

2. Fields of Phil and Carl Grau were treated commercially by airplane with 4.8 ounces of parathion per acre except for check strips left in each field. Counts showed 15 to 20% of the plants to have established colonies of aphids. Counts one or two days later showed an estimated 80 to 85% control. Where control was not obtained, there was a leaf curved over the whorl.

Picker-sheller sampling of the Carl Grau field showed an increase of 5.5 bushels per acre (5.1%) on treated over untreated areas. Sampling of the Phil Grau field by hand showed a loss of 3.7 pounds (2.0%) on the sampled area, which was 131 feet of row, where duplicate samples were harvested.

3. On the Eitenmiller farm near Pekin, we located the heaviest infestation I have ever seen on August 8. A total of 82.5% of the plants had well-established infestations (Table 2). This total is broken down to show 65.5% in the whorls and 17.0% in the tassels.

Table 2. Percent Plants With Well-Established Infestation of Corn Leaf Aphid at Pekin, August 8, 1960.

	200 plants each count	
	In the whorl	In the tassel
Colony well started	17.0	8.5
Heavy infestation	48.5	8.5
Total established infestation	65.5	17.0

This field was treated by airplane on August 12, 13, and 14, with $\frac{1}{4}$ lb. and $\frac{1}{2}$ lb. of parathion. When examined August 16, counts showed that 22.6% of the plants were in whorl and 77.5% in tassel when treated. Control appeared to be 100% on plants in tassel but practically nil on plants in the whorl stage when treated (Table 3). In the whorl stage plant aphids exposed on the leaves were killed, but the plants still had strong colonies of aphids. Less than 1 percent of barren plants showed up on these plots.

Table 3. Control of Corn Leaf Aphids on Eitenmiller Farm, August 1960. Counts of 50 plants each treatment

Plot	Treatment	Plants in whorl when treated		Plants in tassel when treated	
		Number of plants	Estimated control	Number of plants	Estimated control
I	$\frac{1}{4}$ lb. parathion 8/12	5	0.0	45	100.0
II	$\frac{1}{2}$ lb. parathion 8/12	9	0.0	41	100.0
IV	$\frac{1}{4}$ lb. parathion 8/13	16	0.0	34	100.0
III	$\frac{1}{2}$ lb. parathion 8/13	12	0.0	38	100.0
V	Untreated	11	0.0	39	2.0 1/
VI	$\frac{1}{4}$ lb. parathion 8/14	17	0.0	33	100.0
VII	$\frac{1}{2}$ lb. parathion 8/14	9		41	100.0
	Percent of plants	22.6		77.4	

1/ Control by parasites and predators.

Parasites and predators were working strongly. Leaves were brought into the laboratory to see what effect the insectide had on a hymenopterous parasite which was abundant. Table 4 shows that the $\frac{1}{2}$ lb. parathion reduced the number of emerging parasites drastically, but the $\frac{1}{4}$ lb. parathion did not.

Table 4. Effect of Treatment for Control of Corn Leaf Aphid on a Hymenopterous Parasite, Eitenmiller Field, 1960

Treatment	Number of parasitized aphids	Emergence holes	
		Number	Percent
$\frac{1}{4}$ lb. parathion	128	96	75.0
$\frac{1}{2}$ lb. parathion	146	13	8.9
Untreated	141	94	66.7

Data secured at harvest time from hand-picked plots indicate no significant difference in percentages of small ears for treatment on these plots (Table 5). They do show apparent differences in yield. In three cases yields were better on the treated plots than on the check. However, this was not consistent because two of the better yields were with $\frac{1}{2}$ lb. of parathion and one was with $\frac{1}{4}$ lb. of parathion. Mr. Eitenmiller machine-harvested samples from Plots IV and V, and yields showed a difference of 8.2 bushels in favor of Plot IV over Plot V.

Table 5. Harvest Time Data From Eitenmiller Field, 1960.
Hand-Picked Plots

Plot	Treatment	Percent "small" ears By count	Percent "small" ears By weight	Yield per acre combined "good" & "small" ears
I	¼ lb. parathion 8/12	17.9	12.5	87.9
II	½ lb. parathion 8/12	19.4	14.0	93.5
IV	¼ lb. parathion 8/13	15.0	10.3	94.9
III	½ lb. parathion 8/13	19.1	13.7	90.8
V	Untreated	14.7	10.2	86.7
VI	¼ lb. parathion 8/14	19.4	14.6	87.4
VII	½ lb. parathion 8/14	13.2	8.3	94.8

Control of the aphid was the same on all plots. There appeared to be no difference in percentages of small ears. Yields were better on some plots, but not consistently so. Statistical analysis showed significant yield differences by one procedure, but not significant by another procedure. Our results in this test are confusing. Possibly the apparently good yield results were due to control of some insect or insects other than the corn leaf aphid. Maybe timing of the treatments was wrong.

In Illinois tests we still do not have a good case for treating to control the corn leaf aphid.

GIANT FOXTAIL CONTROL

E. L. Knake

Giant foxtail has spread rapidly in Illinois since its introduction 30 years ago, and it can now be found in most parts of the state. It is considered our most serious annual grass--so serious that in 1959 it was added to our Illinois weed law as a noxious weed.

We can be thankful that giant foxtail is an annual and therefore easier and less costly to control than some of our perennials. Although we do not need to worry about regrowth from old plants from the previous season, giant foxtail is a prolific producer of seeds. Some plants produce over 20,000 seeds. Some of the seeds may lie dormant in the soil for many years before they germinate. Seeds of a similar species, yellow foxtail, have remained viable after being in the soil 30 years. As long as we do not have chemicals that are practical for killing dormant seeds in the soil, we can hardly hope for complete eradication. However, once the seeds germinate, the young seedlings will respond to two major methods for early-season control.

Pre-emergence Herbicides. Several of the pre-emergence herbicides that have been discussed are giving good control of giant foxtail. If a farmer can count three or more giant foxtail plants per foot of row on untreated check strips, he can be fairly sure that pre-emergence herbicides will more than pay for themselves in increased corn and soybean yields.

In corn, Randox, Randox-T, Atrazine, and Simazine have all given good control of giant foxtail; 2,4-D ester is less dependable, but it may be effective when rain moves it into the soil soon after application.

In soybeans,where giant foxtail is the major weed problem, Randox has proved to be very effective. Where broadleaved weeds are also a problem, many farmers have turned to Alanap. We will also be keeping our eye on Amiben.

One of the greatest advantages of pre-emergence herbicides is the insurance they offer when wet weather prevents early cultivation. We estimate that pre-emergence herbicides were applied to less than 10 percent of our corn and soybeans in 1960. We have hardly begun to fight giant foxtail with these new chemical weapons.

Cultural Control. When weather and time permit early cultivation, the rotary hoe or harrow and the shovel cultivator can provide effective early-season control of giant foxtail. It's a fine sight in May and June to see clouds of dust from rotary hoes across the land.

Why is early cultivation so important? Giant foxtail has an Achilles' heel, which is the stage in its life cycle before the secondary, or more permanent, root system becomes established. The foxtail can be easily routed with a rotary hoe or harrow before it gets more than an inch tall because at this stage the fine, thread-like mesocotyl between the seed and the crown offers little support. About the time the plant is 2 to 3 inches high, the secondary roots from the crown start going down into the soil and provide a firmer anchor. For successful control with the rotary hoe or harrow, attack giant foxtail early, bofore the crown roots become established. Hit the Achillles' heel.

When using the shovel cultivator to control weeds in the row, be sure to cultivate while the plants are small so that soil can be thrown in on them to smother them.

Many of our fields have giant foxtail primarily along the edges or in certain other areas. Some farmers apply pre-emergence herbicides only to these infested areas. They can do it right after planting if they don't have time while planting or don't have planter attachments for applying herbicides.

Much of the foxtail seed comes from fencerows and waste places. Many more farmers could use post-emergence applications of Dalapon on such areas. A mile of fencerow three feet wide is only a little over one third of an acre. It doesn't take much chemical to do a lot of good on one-third acre. But be sure to spray before the seed heads form.

We have the tools--herbicides and cultivation equipment--for effective giant foxtail control. Let's pat the fellows on the back who are using them and encourage more to use them.

THE ROLE OF CUSTOM SPRAY OPERATORS, DEALERS, AND SALESMEN IN PESTICIDE PUBLIC RELATIONS PROGRAMS

M. P. Jones

The American public has dictated the quality of the foods it wants. The production of such foods makes the use of agricultural chemicals necessary. To stay in business, farmers who grow food of such high quality must produce it efficiently. Everyone in agribusiness who is concerned with pesticides has an important part in helping farmers to attain efficient production. Recommendations for pest control must be carefully prepared. Considerations must be given to state and federal regulations governing residue tolerances, label registrations, effectiveness of the pesticide based on research, the side-effects that may result from use of a particular pesticide, and the practicability, from the farmer's standpoint, of following the recommendations.

When recommendations so formulated are issued, they should constitute the recommendation for the state or district. The extension worker, the pesticide dealer, salesmen, and fieldmen, as well as the applicator should promote the one set of recommendations. It is confusing and sometimes hazardous to have each group that contacts the grower present different recommendations. Everyone concerned can lose when such a practice is followed. The farmer may not receive the greatest returns from his investment in pest control and could lose faith in the practice. When this happens, the pesticide industry loses a customer and the commodity buyer receives an inferior product.

What about public relations beyond the farm? Much of the public concern about the use of pesticides results from their improper use. It is the responsibility of everyone concerned with the use or application of pesticides to see that they are used properly.

Every one of us also has a responsibility to use every opportunity to inform consumers that they are the best fed, best clothed of any people and that this could not be so without the use of properly applied chemicals to control the pests.

January, 1961 NORTHERN AND SOUTHERN LEAF BLIGHTS OF CORN No. 202

by M. P. Britton

Northern corn leaf blight is caused by the fungus Helminthosporium turcicum. This disease is characterized by long, elliptical, grayish-green to tan lesions on the leaves. Typical lesions are 2 to 4 inches long by 1/2 inch wide. On occasion the lesions may attain a length of 6 inches and a width of 1 1/2 inches. During damp weather, masses of dark-colored spores (seeds) of the fungus are produced on the lower surface of the infected leaf, often in concentric zones, which give a target-like appearance to the lesion. Ears are not infected.

Southern corn leaf blight is caused by the fungus Helminthosporium maydis. The typical leaf lesion of this disease has parallel sides and is about an inch long and 1/4 inch wide. The lesions are tan. Occasionally they may have a dark brown to purplish margin. The parallel sides of the lesions distinguish southern leaf blight from northern leaf blight. Ears are not infected.

In both diseases the lesions may become so numerous that nearly all of the leaf blade is involved. The leaves then become a grayish-green, resembling leaves killed by frost.

The disease development pattern is essentially similar in the two leaf blights. The causal fungi live through the winter as mycelium in infected leaves of the previous year's crop. The following summer spores are formed from the mycelium in the leaves. These spores are carried by wind or splashing rain to the lower leaves of the growing corn plant. Infection occurs when free water is present and the temperature is between 60° to 80° F. Successive crops of spores form on the leaf lesions and spread to progressively higher leaves on the plant to continue the disease cycle. Under conditions favorable for the disease, the entire plant may be prematurely killed.

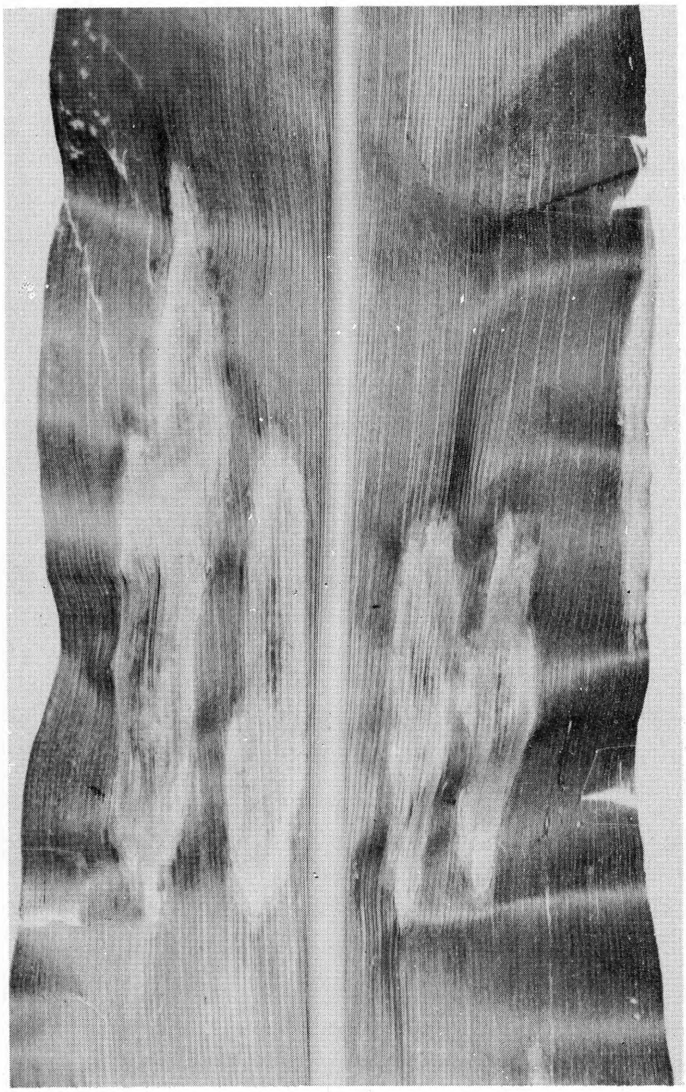
Observations indicate that southern corn leaf blight thrives at somewhat higher temperatures than does northern corn leaf blight. Northern corn leaf blight may occur in all of Illinois; southern corn leaf blight is usually found only in the southern half of the state.

These leaf blights may reduce grain yield 30 percent or more if the disease becomes severe two or three weeks after silking. The reduction is less when the disease appears later in the season. A marked increase in stalk rot almost invariably occurs in fields that have been badly blighted.

Northern and southern corn leaf blights are most effectively controlled by planting resistant hybrids. Resistance is usually directly proportional to the number of resistant inbreds used in making up the hybrid.

Leaf blight reactions of 228 inbred lines are given in Report on Plant Diseases No. 203. All of these are rather late maturing but can be used in hybrids for central and southern Illinois.

These blights have been successfully controlled on sweet corn in Florida with fungicide sprays and dusts. The fungicides Maneb and Zineb have given excellent control. Effective control with fungicides involves repeated spraying or dusting from silking to maturity. This treatment is not economically feasible in Illinois except in hybrid dent corn seed fields and late-maturing sweet corn raised for fresh market. Seed treatments and rotations are not effective as controls for these diseases.



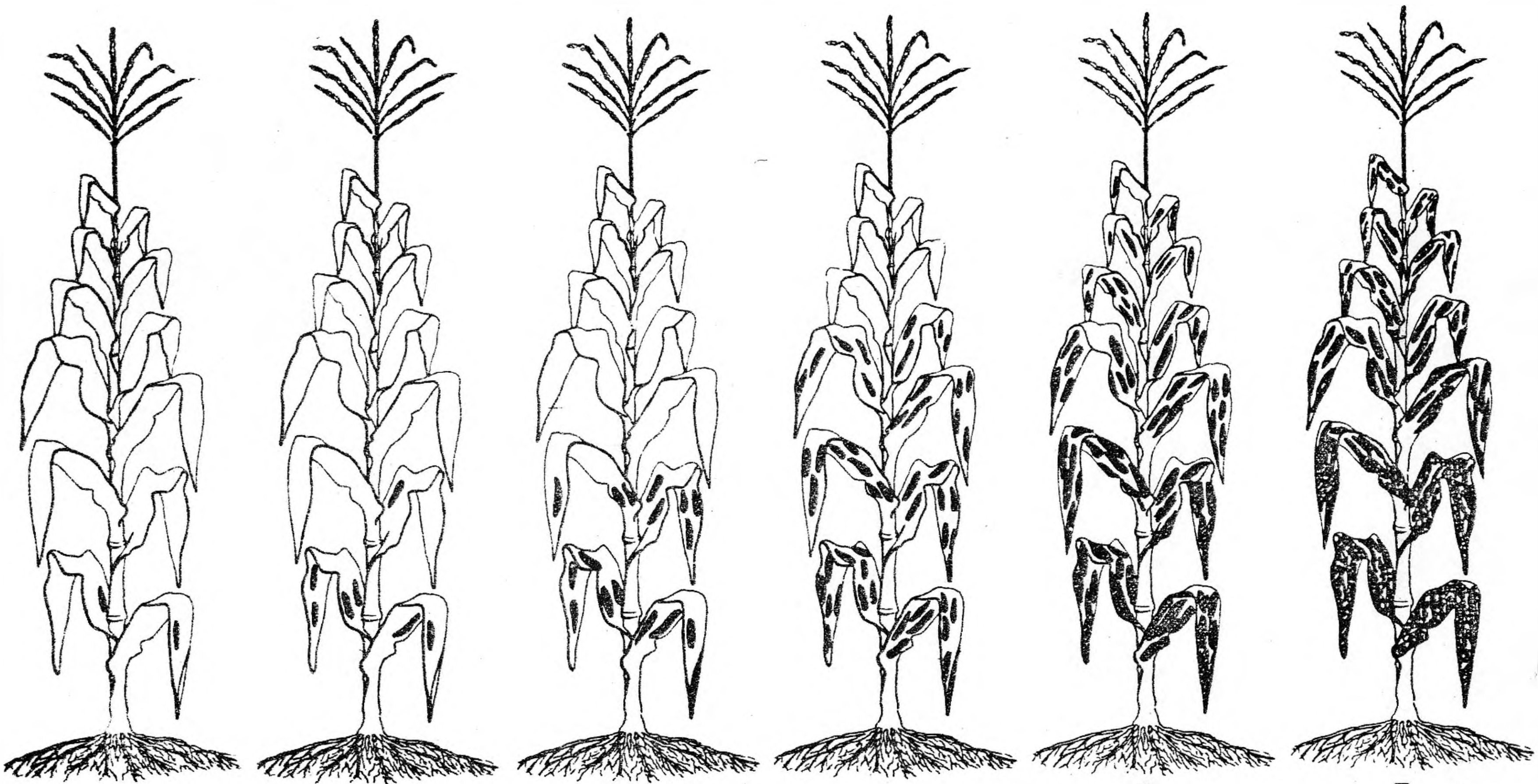
Northern corn leaf blight

Southern corn leaf blight

* Photographs courtesy of A. J. Ullstrup, Research Pathologist, ARS, Purdue University, Lafayette, Indiana.

Cooperative Extension Work in Agriculture and Home Economics
University of Illinois College of Agriculture and the United States
Department of Agriculture cooperating. Louis B. Howard, Director.
Acts approved by Congress May 8 and June 30, 1914.

SCALE FOR ESTIMATING HELMINTHOSPORIUM TURCICUM LEAF BLIGHT



0.5	1	2	3	4	5
VERY SLIGHT INFECTION ONE OR TWO RESTRICTED LESIONS ON LOWER LEAVES	SLIGHT INFECTION A FEW SCATTERED LESIONS ON LOWER LEAVES	LIGHT INFECTION MODERATE NUMBER OF LESIONS ON LOWER LEAVES	MODERATE INFECTION ABUNDANT LESIONS ON LOWER LEAVES FEW ON MIDDLE LEAVES	HEAVY INFECTION LESIONS ABUNDANT ON LOWER AND MIDDLE LEAVES EXTENDING TO UPPER LEAVES	VERY HEAVY INFECTION LESIONS ABUNDANT ON ALL LEAVES PLANTS MAY BE PREMATURELY KILLED

Table 1. Bluegrass Lawn Disease Control Timetable

Disease	Time of Occurrence	Suggested fungicides or control measures	Rate per 1000 square feet	Intervals between applications
Snow molds	Dec.-Apr.	Mercury chlorides Thiram Cadmium compounds	1-4 oz. 6-8 oz. see label	Apply in November before the first snow. Reapply during winter or spring as snow melts if disease is present.
Leafspots and footrot	Apr.-June	Phenyl mercury Cycloheximide Zineb Phaltan Captan Cadmium compounds	1-1½ oz. ½ oz. 4-6 oz. 2-4 oz. 2-4 oz. 2-6 oz.	Make the first application in late April--reapply twice more at 14- to 20-day intervals. If disease still becomes serious, reduce interval between sprays to 7-10 days. Merion bluegrass is resistant to leafspot and footrot.
Rust	July-Nov.	Keep lawn fertilized and watered to produce at least 1 inch of new growth per week.		Do this even if fungicides are used.
		Cycloheximide Zineb	½-1 oz. 2-3 oz.	3 applications at 7-day intervals.
Brown patch	June-Sept.	Organic mercuries Mercury chlorides Thiram Thiram + mercury chlorides Cadmium compounds	½-1 oz. 1½ oz. 4-6 oz. 2 oz. + 1 oz. 2-6 oz.	Repeat at 7-day intervals until disease spots are removed by mowing.
Helminthosporium blight and Pythium blight	July-Sept.	Zineb + thiram Zineb Cycloheximide Cadmium compounds Mercury compounds	2 oz. + 2 oz. 2-6 oz. ½-1 oz. 2-6 oz. ½-1 oz.	Repeat applications at 3- to 7-day intervals if disease starts to spread again. Small dead areas recover over winter from rhizomes and reseed large dead areas in September.
Powdery mildew	Sept.-Nov.	Dinitrocaprylphenyl	½-1 oz.	Two applications - 10 days apart.
Fairy rings	--	No good control measures. Try the following: Loosen soil in ring with a spading fork. Drench the loosened soil with mercury chloride or organic mercury fungicides mixed with household detergent. Apply two times at 10-day intervals, using at least 1 quart of solution per square foot of soil surface.		

Table 2. Recommended Fungicides for Bluegrass Lawn Diseases

Fungicide	Trade names
Mercury chlorides	Calo-clor, Calocure, Calogreen, Fungchex, Woodridge Mixture 21, Bi Cal
Cadmium compounds	Kromad, Formula Z
Thiram	Tersan 75, Spotrete, Arasan 75, Panoram, Thiram, Kromad
Phenyl or organic mercury	Puratized Agricultural Spray, Tag, Semesan Turf Fungicide, Liquiphene Turfgrass Fungicide, Merbam-10, Pmas, PMA, Panogen Turf Spray, etc.
Cycloheximide	Actidione--Ferrated, Actidione RZ, Acti-tabs
Zineb	Parzate Zineb Fungicide, Dithane Z-78, Fungicide A, Blightox 65-W, etc.
Captan	Captan 50-W, Orthocide 50-wettable, Orthocide Garden Fungicide
Phaltan	Ortho Phaltan 50-W
Dinitrocaprylphenyl	Karathane WD,

PRE-EMERGENCE HERBICIDES FOR 1961

E. L. Knake, F. W. Slife and W. O. Scott

Several weed chemicals are now available to farmers for use in field crops. Those that have attracted a considerable amount of interest in the past few years are the ones called pre-emergence herbicides. These are weed chemicals that are applied to the soil before the crops or weeds emerge. They are applied at the time of planting, usually in the same operation.

One of the greatest benefits that farmers can expect from pre-emergence herbicides is the control of annual grasses. Research at Urbana has pointed out how markedly corn and bean yields can be affected by annual grasses left growing in the row. We do not mean to minimize the importance of eliminating broad-leaved weeds as well as grasses. However, ordinary mechanical methods plus the post-emergence use of 2,4-D in corn usually provide good control of broad-leaved weeds. On the other hand, grasses are resistant to post-emergence applications of 2,4-D, and ordinary cultivation often fails to control them satisfactorily in the row. For this reason, farmers are now looking at pre-emergence herbicides with more and more interest. Pre-emergence treatments are recommended for serious weed problems that cannot be handled by ordinary practices.

The accompanying table gives the pre-emergence recommendations for controlling weeds in corn and soybeans. Following the table is a brief description of the characteristics of each of these herbicides.

Weeds	Pre-emergence herbicides	Amount to apply per acre in 12- to 14-inch band 1/	
		Liquid	Granular
Corn			
Annual grasses	Randox	1 1/3 qt.	7 lb. (20% a. i.) 4/
	Simazine 5/	1 1/4 lb.	
	Atrazine 5/	1 1/4 lb.	5 lb. (20% a. i.)
Annual grasses and broad-leaved weeds	Simazine 5/	1 1/4 lb.	
	Atrazine 5/	1 1/4 lb.	5 lb. (20% a. i.)
	Randox-T (trial use)	1 1/2 qt.	10 lb. (35% a. i.)
	2,4-D ester 2/	1/2 lb. 3/	3 1/3 lb. (20% a. i.)
Johnsongrass (from seed) or wild cane	Eptam 2/	2/3 qt.	20 lb. (5% a. i.)
Soybeans			
Annual grasses	Randox	1 1/3 qt.	7 lb. (20% a. i.)
	Alanap 2/	2/3 gal.	14 lb. (10% a. i.)
Annual grasses and broad-leaved weeds	Alanap 2/	2/3 gal.	14 lb. (10% a. i.)
	Amiben (seed beans only)	2 qt.	10 lb. (10% a. i.)

1/ For band spraying, use the indicated amount of liquid herbicide in 7 to 10 gallons of water per acre. For broadcast application, apply three times these amounts.

2/ These materials sometimes cause crop injury. See discussion.

3/ Actual amount of active ingredient (2,4-D acid).

4/ a. i. stands for active ingredient. The amount listed is for material with the indicated percent of active ingredient.

5/ Amount to use depends on type of soil. See discussion.

Randox is recommended for controlling annual grasses in corn and soybeans. It may also control some broad-leaved weeds, but not consistently enough to suggest it for this purpose. Because both crops are tolerant to this chemical, there is little chance of crop injury. Randox is relatively soluble and usually works better under limited rainfall conditions than 2,4-D ester or Atrazine. About half an inch of rain within a week or 10 days after treatment seems to be enough to give good control of grasses. It is not recommended for use on sandy soils because rainfall would readily leach it out of the surface soil.

Randox is irritating to the skin and eyes. Rubber gloves and goggles should be worn when spraying this herbicide. The skin irritation problem is reduced with the granular form of Randox.

Granular Randox, if properly applied, seems to be equal in performance to liquid Randox.

Randox-T is Randox with an additive. It controls many of the annual broad-leaved weeds as well as the annual grasses. It should be used only on corn to be harvested for grain. It should not be used on soybeans, silage corn, or crops other than corn. Randox-T is available in both liquid and granular form. Extreme care must be used when handling either the granular or the liquid form, to prevent irritation to the skin and eyes. The granular form is less likely to cause irritation than the liquid form.

Atrazine is a pre-emergence herbicide that has the ability to control both annual grasses and broad-leaved weeds throughout the entire season. At the same time, corn has such a high degree of tolerance to Atrazine that injury is unlikely. After band spraying in the spring, there is little chance of injury to small grains that follow the next spring if the soil is plowed or disked in the fall. Seeding a crop in the fall after the corn is harvested is not recommended. There seems to be no danger to soybeans following corn treated with Atrazine when the soil is plowed in either the spring or the fall.

The recommended rate for broadcast application of Atrazine is 2 to 4 pounds of active ingredient per acre. For most Illinois soils 3 pounds is best. On light soils, particularly sand or sandy loams, 2 pounds is sufficient. In a few areas where soils are high in organic matter, 4 pounds is necessary to get good weed control. Atrazine is available as a wettable powder with 80% active ingredient. The recommended rates for broadcast application of the 80% material are 2 1/2, 3 3/4, and 5 pounds to equal the recommended rates of 2, 3, and 4 pounds of active ingredient. For application in a 13- to 14-inch band, the rates of 80% material to use are 5/6, 1 1/4, and 1 2/3 pounds per acre. In 1960 more failures were reported with granular Atrazine than with the wettable powder. These failures were apparently caused by poor application and formulation problems. On the basis of past performance, the wettable powder is recommended over the granular formulations for 1961.

The amount of rainfall after application is very important to the success to be expected with Atrazine, since it is so insoluble. During the ten-day period after treatment, it seems to require about 3/4 inch of rainfall to give satisfactory results.

Simazine is similar to Atrazine in all respects except that Atrazine is slightly more soluble in water.

2,4-D ester (not amine) may be applied as a pre-emergence in corn, but with certain reservations because of crop injury. When injury occurs, it appears mostly in the form of stand reduction or seedling malformation. Because of heavy rains after planting in 1960, more corn was injured from pre-emergence 2,4-D than in previous years. Planting at least 2 inches deep will minimize the chance of injury. Pre-emergence applications of 2,4-D should not be used on sandy soils.

If a good rain occurs within a few days after treatment, 2,4-D ester will control both annual grasses and broad-leaved weeds. If the weather is dry for as long as a week, the chance of getting good control of grass will be greatly reduced.

The main advantage of 2,4-D over the other herbicides is its low cost. At present it is cheap enough to apply as a broadcast application and still cost less than band applications of the other materials.

2,4-D granulars will be available in 1961 in concentrations of both 10% and 20% of active ingredient. Granular 2,4-D is recommended at 2 pounds of active ingredient per acre compared with 1 1/2 pounds for the liquid ester of 2,4-D. It will be necessary to apply 10 pounds of 20% granular or 20 pounds of 10% granular 2,4-D per acre to obtain 2 pounds of 2,4-D acid per acre. To obtain good weed control and minimize the possibility of damage, uniform application of granules is important.

Eptam is not recommended for general control of weeds in corn, but it is highly recommended for control of wild cane and Johnsongrass seedlings in corn. For best results it should be incorporated in the top inch of soil as soon as possible after planting. This can be done with a rotary hoe or a spike-tooth harrow without disturbing the planted corn very much. The recommended broadcast rate is 3 pounds of active ingredient per acre in either granular or liquid form.

One of the most outstanding things about Eptam is its ability to perform exceptionally well in dry soil. It has also given good results under wet conditions.

Eptam will injure corn occasionally. The injury occurs as stand reduction and malformation of corn seedlings. Even with this possible hazard, the damage is not as severe as the yield reductions caused by Johnsongrass and wild cane.

Alanap is available for controlling grass and broadleaved weeds in soybeans. It does not control smartweed, however. Soybeans do not have good tolerance to Alanap; and when sufficient rain occurs to move the material into the zone where the soybean seeds are germinating, injury may result. In most cases soybean seedlings that are stunted usually recover. In 1960, with the widespread heavy rains, injury was more common and more severe than usual. Some fields were replanted because of injury. Deep planting helps to prevent injury but also increases the problem of getting the soybeans through the soil. Alanap is fairly soluble in water. It will probably give satisfactory results on most soils when about half an inch of rain falls within a week or 10 days after application. The increased possibility of injury discourages its use on sandy soils.

Amiben, a new pre-emergence material, is recommended for the control of grasses and broad-leaved weeds in soybeans grown for seed. It has not been cleared for use in soybeans grown for feed or processing. Field results in 1959 and 1960 have been highly successful. Three pounds of active ingredient per acre seems sufficient to give good control of weeds.

Cultivation should be delayed as long as possible after a successful band application of any pre-emergence herbicide. Otherwise a new supply of weed seed is uncovered or introduced into the weed-free band, and the effectiveness of the treatment is reduced.

When using herbicides, be sure to follow directions carefully. Read the instructions on the container. Use the necessary safety precautions. Calibrate your applicator accurately, and apply the recommended amounts. Use herbicides to control weeds only in the crops for which they are approved, and at the proper time.

The pre-emergence herbicides described here are not perfect, but they are evidence that definite progress is being made in this field. A great deal of actual crop tolerance to some of these materials has been found. This has made it possible to achieve some selective weed control that was once considered almost impossible. Some of the new materials are more reliable under different weather conditions than was true of the earlier pre-emergence herbicides. We have now reached the point where the recommended chemicals can be expected to work often enough under Illinois conditions to more than repay the farmer for the time and cost involved in using them. The insurance that pre-emergence herbicides provide for early control of weeds is probably their greatest attribute.

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INSECTS OF CABBAGE AND RELATED COLE CROPS

Insects	NHE No.	Approximate time of attack	Insecticides: Name	Lb. of active ingredient per acre	Placement	Timing of application
Cabbage maggot	44	Early spring	Aldrin Dieldrin	1/4 1/4	Seed bed	At seeding.
			Aldrin	1		In soil, row or band.
			Aldrin Dieldrin	2 oz. actual per 50 gal. transplant water		6 fluid oz. transplant water per plant.
			Parathion	3	Soil	Preplanting broadcast and disked in. Suggested for direct-seeded cabbage.
Aphid	47	Throughout season	Malathion Phosdrin Parathion	1 1/4 0.4	Foliage	When aphids appear, but before leaves begin to curl.
Diamond-back moth larva Imported cabbage worm Cabbage looper		June	Dibrom Endrin	1 1/2	Foliage	When small worms first appear, and about every 10 days thereafter.
			Perthane with Diazinon or Malathion or Parathion or Phosdrin	1 1/2 1 0.4 1/2	Foliage	
Thrips	48	At onion harvest	Dieldrin	1/4	Foliage	As needed.
Cutworm		At planting	Aldrin Dieldrin	2 1	Soil	Preplanting, disk in.
			Dieldrin	1/2	Foliage	As needed, when first damage occurs.

(See other side for restrictions.)

Insects	NHE No.	Approximate time of attack	Insecticides: Name	Lb. of active ingredient per acre	Placement	Timing of application
Leafhopper		Throughout season	DDT	1 1/2	Foliage	As needed.
Flea beetle		Throughout season	DDT	1 1/2	Foliage	As needed.

1961 Restrictions on Use of Insecticides Recommended for Cole Crops.
Expressed in Days Between Application and Harvest. Read Labels and Follow Precautions.

Crop	Aldrin	DDT	Diazinon	Dibrom	Dieldrin	Endrin	Malathion	Parathion1/	Perthane	Phosdrin1/
Broccoli	14,A	B	5	4	30,A	B	3	7	3	1
Brussels sprouts	14,A	B	--	4	30,A	B	7	7	3	3
Cabbage	21,A	B	7	4	21,A	B	7	7	3	1
Cauliflower	21,A	B	5	4	21,A	B	7	7	3	3
Horseradish	7,A	C	--	--	21	--	7	--	--	--
Radish	7,A	C	10	--	21	--	7	21	--	--
Turnip	14,A	C	10	4	30,A	--	3	21	--	3

A - No restrictions on preplanting or planting soil treatments.
B - Do not apply after edible portions have begun to form.
C - No time limitations, but if tops are to be used for feed or food, do not apply after seedling stage.
1/ To be used only by commercial gardeners or professional applicators.
Follow label precautions on use of crop residues for livestock feed.

WHL and HBP

Those who produce vegetables commercially should record for each crop the names of all chemicals used, the amount used, method and date of application, and date of harvest.

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INSECTS OF VEGETABLE SALAD CROPS

			Insecticides			
Insects	NHE No.	Approximate time of attack	Name	Lb. of active ingredient per acre	Placement	Timing of application
Aphid	47	Throughout season	Diazinon Malathion Parathion Phosdrin	1/2 1 0.4 1/4	Foliage	As needed.
Cutworm		On seedling plants	Aldrin Dieldrin	1/2 1/2	Base of plant and soil	When first damage appears.
Leafhopper		Throughout season	DDT Malathion	1 1/4 1	Foliage	When first leafhoppers appear and as needed.
Caterpillar		Throughout season	Dibrom	1	Foliage	As needed.
			Perthane with Diazinon or Malathion or Parathion or Phosdrin	1 1/2 1 0.4 1/2		
Leaf miner		Throughout season	Parathion	0.4	Foliage	When first miners are observed.
Flea beetle		Throughout season	Rotenone DDT	1/4 1	Foliage	As needed.

(See other side for restrictions.)

1961 Restrictions on Insecticides Recommended for Vegetable and Salad Crops.
Expressed in Days Between Application and Harvest. Read Labels and Follow Precautions.

Crop	Aldrin	DDT	Diazinon	Dibrom	Dieldrin	Malathion	Parathion 1/	Perthane	Phosdrin 1/	Rotenone
Collards	14	A	10	4	21	7	21	--	3	B
Kale	14	A	10	4	21	7	21	--	3	B
Lettuce	30	A	10	4	21	10	21	4	2	B
Spinach	14	A	10	4	21	7	7	7	4	B
Swiss chard	14	A	12	4	21	7	21	--	--	B

A - Do not apply after edible portions have begun to form.
B - No restrictions.
1/ To be used only by commercial gardeners or professional applicators.
Follow label precautions on use of crop residues for livestock feeds.

WHL and HBP

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INSECTS OF TOMATOES AND EGGPLANT

Insects	NHE No.	Approximate time of attack	Insecticides: Name	Lb. of active ingredient per acre	Placement	Timing of application
Cutworm, subterranean	38	May-June	Dieldrin Heptachlor Aldrin	1 1 1/2 2	In soil	Preplanting broadcast treatment, disked in.
Cutworm, climbing	77		Aldrin Dieldrin Toxaphene	1/2 1/4 2	Foliage	As needed.
Flea beetle		May-June	DDT Rotenone Sevin	1 0.2-0.4 2	Foliage	Apply every week as long as needed.
Aphid	47	May-July	Thiodan Malathion Diazinon Parathion	1/2 1 1/4 0.4	Foliage	As needed, but before leaves curl.
Corn earworm		July-Sept. Occasionally even in June	DDT Toxaphene Sevin	1 2 2	Foliage	Weekly applications of fungicide sprays beginning at first fruit set. If spraying is infrequent, use 3 lb. of DDT or 6 lb. of toxaphene.
Hornworm		July-Sept.	Toxaphene Sevin	3 2	Foliage	When first small worms appear.
Mites (several species)		July-Sept.	Kelthane Malathion Parathion Trithion	1/2 1 0.4 1	Foliage	As needed.

(over)

Insects	NHE No.	Approximate time of attack	Insecticides: Name	Lb. of active ingredient per acre	Placement	Timing of application
Russet mites		July-Sept.	Parathion Sulfur dust Sulfur	0.4 30 lb. of 20-50% 10 lb. as spray	Foliage	As needed.
Blister beetle	72	June-Sept.	Parathion Toxaphene	1/4 2	Foliage	As needed.
Fruit fly		Aug.-Oct.	Aldrin Diazinon Pyrethrin dust	1/2 1/4	Foliage	When flies first appear, apply aldrin or diazinon--usually at 1st harvest. Apply pyrethrin dusts to hamper immediately after it is filled.

1961 Restrictions on Use of Insecticides Recommended for Tomatoes and Eggplant.
Expressed in Days Between Application and Harvest. Read and Follow Label Precautions.

Crop	Aldrin	DDT	Diazinon	Dieldrin	Heptachlor	Kelthane	Malathion	Parathion 1/	Sevin	Sulfur	Trithion	Thiodan	Toxaphene
Eggplant	3	5	---	7	A	2	3	15	B	B	7	7	5
Tomatoes	1	5	1	7	A	2	3	10	B	B	7	7	5

A - For soil treatment at or before planting.
B - No restrictions.
1/ Parathion should be applied only by commercial gardeners or professional applicators.
Follow label precautions on use of crop residues for livestock feeds.

WHL and HBP

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INSECTS ON ONIONS

Insects	NHE No.	Insecticides: Name	Lb. of active ingredient per acre	Placement	Timing of application
Onion maggot	50	Diazinon	1/2-1 lb. to 40-50 lb. of seed.	Seed	Seed treatment for set onions only. Use lighter dosage of diazinon on sandy, highly mineral soils.
		Ethion	1 lb. to 40-50 lb. of seed.		
		Ethion Trithion	1-2	In furrow	Use 1.0 lb. actual per acre for rows 12" apart; 3/4 lb. for rows 18" apart; 1/2 lb. for rows 24" apart. Up to double dosage necessary on muck soils.
		Diazinon	2	Broadcast	Preplanting. Disk into upper 1 to 2 inches of soil.
		DDT Diazinon Malathion Parathion	2 1/3 1 1/3	Foliage spray	Supplemental to soil treatment. Make first application with DDT when first adult flies are seen. Make another 2 weeks later. From then on use any of the insecticides, but only as necessary.
Thrips	48	Parathion DDT Diazinon Dieldrin	1/2 1 1/2 1/2 1/4	Foliage	When injury first appears and every 10 days as necessary.
Cutworm		Dieldrin	1/4	Foliage	As needed.

WHL and HBP

(See other side for restrictions.)

1961 Restrictions on Use of Insecticides Recommended for Insects on Onions.
Read Labels and Follow Precautions.

There are no restrictions on the use of ethion as a furrow treatment at planting.
Trithion can be used as a furrow treatment for dry onions, but not for green bunching onions.
Do not apply dieldrin or DDT to green bunching onions.
Do not apply diazinon to onion foliage within 10 days, parathion within 15 days, malathion within 3 days, or dieldrin within 14 days of harvest of dry onions.
Parathion should be applied by commercial gardeners and professional applicators only.
Follow label precautions on use of crop residues for livestock feeds.

WHL and HBP

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INSECTS ON CUCURBITS AND OTHER VINE CROPS

Insects	NHE No.	Approximate time of attack	Insecticides: Name	Lb. of active ingredient per acre	Placement	Timing of application
Seed maggot	27	Germination	Dieldrin	According to manufacturer's directions	Seed	Protects seed only at planting time.
Striped and spotted cucumber beetles	46	Seedling to mature plants	Dieldrin Sevin	1/4 to 1/2	Foliage spray	When beetles first appear; as often as necessary thereafter.
			Dieldrin	1	Soil treatment	Preplanting broadcast application. Disked in.
Aphid	47	All stages	Diazinon Malathion Phosdrin Parathion	1/2 1 1/4 1/2	Foliage	When aphids become noticeable.
Squash bug	51	All season	Dieldrin Sevin	1/2 1	Foliage	Do not apply until first eggs are found hatching (6/15--7/15).
Leafhopper		July-Aug.	Malathion	1	Foliage	As needed.
Squash vine borer		June-Sept.	Lindane	1/4	Base of stem and runners for 3 ft. from stem	Weekly applications when vines begin to run--5 applications.
Pickle worm		Aug.-Sept.	Lindane Sevin	1/4 1	Foliage	Weekly applications beginning in late August.
Cutworm		May-June	Aldrin Dieldrin	2 1	Soil	Preplanting. Disk in.

(See other side for restrictions.)

1961 Restrictions on Use of Insecticides Recommended for Cucurbits and Other Vine Crops. Expressed in Days Between Treatment and Harvest. Read and Follow Label Precautions.

Crops	Aldrin	Diazinon	Dieldrin	Lindane	Malathion	Parathion1/	Phosdrin1/	Sevin
Cucumber	A	7	A, 7	1	1	15	1	C
Melon	A	3	A, B	1	1	7	14	-
Pumpkin	A	-	A, B	1	3	10	14	-
Squash	A	7	A, B	1	1	15	14	C

A - No restrictions on use as soil treatment prior to or at planting.
B - Do not apply after blossoming.
C - Up to and including day of harvest.
1/ To be applied by commercial gardeners or professional applicators only.
Follow label precautions on use of crop residues for livestock feeds.

WHL and HBP

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INSECTS ON BEANS

Insects	NHE No.	Insecticides: Name	Lb. of active ingredient per acre	Placement	Timing of application
Seed maggot	27	Lindane Dieldrin Aldrin	Manufacturer's directions	Seed	At seeding. Preplanting soil treatment of 1/8 lb. of aldrin as band over row at planting can be used also.
Bean leaf beetle		DDT Toxaphene Methoxychlor Malathion Sevin	1 1 1/2 1 1/2 1 1	Foliage	When feeding first appears and weekly for 2 or 3 applications as needed.
Leafhopper and plant bug	22 68	Methoxychlor Malathion Sevin DDT	1 1/2 1 1 1	Foliage	When tiny wedge-shaped green leafhoppers appear and before plants become yellow and stunted. Repeat applications at 1-week intervals as necessary.
Mexican bean beetle		Sevin Malathion Thiodan	1/2 1 1/2	Foliage	When occasional leaves show lacework feeding.
Aphid	47	Malathion Thiodan	1 1/2	Foliage	Before leaves begin to curl and deform. Usually applied when a few aphids can be found on each plant.
Blister beetle	72	Toxaphene Parathion	2 1/4	Foliage	As needed.
Corn earworm	33	Sevin	1	Foliage	As needed.
Mites		Malathion Kelthane Trithion	1 0.4 3/4	Foliage	As needed.

(See other side for restrictions.)

1961 Restrictions on Use of Insecticides Recommended for Insects on Beans.
Read Labels and Follow Precautions.

Do not apply DDT within 7 days of harvest; malathion within 1 day of harvest; methoxychlor within 3 days of harvest; parathion within 15 days of harvest; trithion within 7 days of harvest; or kelthane within 7 days of harvest. Sevin may be applied up to and including the day of harvest.
Do not apply thiodan or toxaphene after pods form.
Parathion should be applied only by commercial gardeners or professional applicators.
Follow label precautions on use of crop residues for livestock feed.

WHL and HBP

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INSECTS ON POTATOES

Insects	NHE No.	Approximate time of attack	Insecticides: Name	Insecticides: Lb. of active ingredient per acre	Insecticides: Placement	Insecticides: Timing of application
Flea beetle		May-July	DDT Thiodan	1 1/2 (as spray) 1/2 (as spray) 1 (as dust)	Foliage	When first damage appears on leaves and repeat as needed.
Colorado potato beetle		May-July	DDT Thiodan	1 1/2 (as spray) 1 (as dust)	Foliage	As needed.
Potato leafhopper	22	May-July	DDT Thiodan	1 1/2 (as spray) 1 (as dust)	Foliage	Weekly applications when green leafhoppers first appear.
Aphid	47	Throughout season	Thiodan Malathion Parathion	1/2 (as spray) 1 (as dust) 1 1/4	Foliage	As needed.
Blister beetle	72	Throughout season	Toxaphene Parathion	2 1/4	Foliage	As needed.
Wireworm	43	Throughout season	Aldrin Dieldrin	2 2	Soil	Preplanting, disk in.
White grub	23	Throughout season	Aldrin Dieldrin	3 2	Soil	Preplanting, disk in.
Grasshopper	74	July-Sept.	Aldrin Dieldrin Toxaphene	1/4 1/8 2	Foliage	As needed--control in fence rows, roadsides, ditch banks, etc., before migration occurs.

Phorate (Thimet) can be used as a furrow or band treatment at planting time at the rate of 2 to 3 lb. per acre for the control of aphids, fleabeetles, and leafhoppers. Do not use in muck soils.

(See other side for restrictions.)

1961 Restrictions on Use of Insecticides Recommended for Insects on Potatoes.
Expressed in Days Between Application and Harvest. Read Labels and Follow Precautions.

There are no restrictions on the use of DDT, malathion, thiodan, or toxaphene on potato foliage.
Allow 5 days to elapse between application of parathion and harvest, and 21 days when dieldrin is used.
Parathion should be applied only by commercial gardeners or professional operators.
Follow label precautions on use of crop residues for livestock feed.

WHL and HBP

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INSECTS ON SWEET CORN

Insects	NHE No.	Approximate time of attack	Insecticides: Name	Insecticides: Lb. of active ingredient per acre	Insecticides: Placement	Insecticides: Timing of application
Soil insects		April-Aug.	Aldrin	1 1/2--3	In soil	Broadcast prior to planting. Disk in immediately unless applied during winter.
Cutworm	38		Heptachlor	1 1/2--3		
Grub	23		Dieldrin	1		
Grape colaspis	25					
Rootworm	26					
Seed corn maggot	27					
Seed corn beetle	27					
Root aphid	31					
Wireworm	43					
Cutworm	23	April-June	Endrin	1/4	Base of plants	When first damage appears. Use large quantities of water per acre.
Flea beetle	36	April-July	DDT	1 1/2	Foliage	As necessary. (Dieldrin soil treatment recommended.)
Corn borer		June, July, August	DDT	1 (granule) 1 1/2 (spray)	Foliage	If tassel ratio is 20 or more with 20 unhatched egg masses per 100 plants, make first application at T.R. 30-40. Repeat at 4- to 5-day intervals as long as field has 20 or more unhatched egg masses per 100 plants. (For further information on 1st and 2nd generation borer control, see U. of I. Cir. 773.)
Corn earworm	33	June-Sept.	DDT	1 1/2 plus 2 1/2 gals. of mineral type oil in 25 gals. water per acre.	Ear zone	At 10% silk and each 3-4 days thereafter for 4 applications. (Early tassel spray without oil may be required. See U. of I. Cir. 739.)
			Sevin1/	1 3/4 - 2		

(See other side for restrictions.)

1/ Use 85 percent formulation only.

Sweet Corn

Insects	NHE No.	Approximate time of attack	Insecticides: Name	Lb. of active ingredient per acre	Placement	Timing of application
Dusky sap	10	July-Sept.	Parathion Malathion	1/2 1	Foliage	When adults first appear in field. Usually between pollen shedding and silk drying.
Corn leaf aphid	29	July-Sept.	Parathion Malathion Phosdrin	1/4 1 1/4	Foliage	As needed to produce attractive ears for fresh market.

1961 Restrictions on Insecticides Recommended for Insects on Sweet Corn.
Read Labels and Follow Precautions.

Allow 12 days to elapse between treatment with parathion and harvest, and 1 day with phosdrin.
Parathion and phosdrin should be applied only by commercial gardeners or professional applicators.
Follow label precautions when using treated crop residues for livestock feed.

WHL and HBP

Those who produce vegetables commercially should record for each crop the names of all chemicals used, the amount used, method and date of application, and date of harvest.

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CONDENSED INSECTICIDE RECOMMENDATIONS FOR FIELD CORN INSECTS

Insects	NHE No.	Approximate time of attack	Insecticides: Name	Lb. actual per acre		Placement	Timing of application
Seed corn maggot Seed corn beetle	27	At time of germination	Dieldrin Heptachlor	Follow manufacturer's directions.		On seed	Protects the seed only at planting time (also soil applications, as for rootworms).
Southern and northern corn rootworm	26	June-August		Broadcast	In row		
			Aldrin Heptachlor	1 1/2 1 1/2	1 1	In soil In soil	Preferably two weeks or more before planting. If broadcast, work into soil immediately.
Wireworm	43	May-July	As for rootworm, but use 3 lb. on peat soils or for high populations of large worms.				
Grape colaspis	25	May-July	As for rootworm.				
White grub	23	June-October	Aldrin Heptachlor	3 3		In soil	Broadcast and disk in. 1 to 1 1/2 lb. kills only small grubs.
Sod webworm	42	May and June	DDT	1 1/2		Over row	At time of initial attack.
Cutworms	38	May and June	Preplant soil treatment, broadcast only.				
			Dieldrin Toxaphene Endrin	1/2 3 1/4		At base of plant.	When damage is first noticeable; high gallonage of finished spray needed.
Grasshopper	74	June-September	Dieldrin Toxaphene	1/8 1 1/2		On entire plant	As needed.
Flea beetle	36	May and June	DDT Dieldrin	1 1/2 1/4		Over row	When damage becomes apparent on small corn.
Armyworm	21	May and June	Dieldrin Toxaphene	1/4 1 1/2		Over row	At first migration or when damage first becomes apparent.
Fall armyworm	34	June, August and September	DDT Toxaphene	1 1/2 1 1/2		In whorl as granules.	When plants show leaf ragging. When silking (see earworm). Granules preferred.
Chinch bug	35	June, July August	Dieldrin Endrin	1/2 1/4		At base of plant	At beginning of migration. Also apply strip in adjacent grain.
Thrips	39	June	DDT	1 1/2		As foliage spray	When severe wilting and severe discoloration are noticeable.
Corn leaf aphid	29	July-September	Malathion Parathion Phosdrin	1 1/4 1/4		As foliage spray	Usually at pretassel when aphids are thick on occasional plants.

Insect	NHE No.	Approximate time of attack	Insecticides: Name	Lb. actual per acre	Placement	Timing of application
Corn borer, first generation		June-July	DDT	1 1/2 as spray; 3/4 to 1 as granules	On upper 1/3 of plant and into whorl.	Tassel ratio 30 to 50, 75% or more plants show recent borer feeding in whorl
			(Toxaphene as granules, or endrin as spray or granules, may also be used.)			
Corn borer, second generation		Mid-August	DDT Endrin	As for first 1/4	From ear upward	When eggs are first found hatching in late-planted fields.
Corn earworm	33	July, August	DDT	1 1/2 plus 2 gal. of earworm oil	In ear zone	2 to 4 applications at 3- to 5-day intervals, starting at 10% silk. 25 gal. of finished spray per acre.

RESTRICTIONS ON USE OF RECOMMENDED INSECTICIDES ON CORN

This table gives the required time interval in days between application and pasturing or harvesting of corn for grain, ensilage, or stover. Further limitations or qualifications are listed in the footnotes. Read labels carefully and follow precautions.

	Aldrin	DDT	Dieldrin	Endrin	Heptachlor	Malathion	Parathion	Phosdrin	Toxaphene
Field corn-seed and soil	B		B		B				
-grain		B	60	45 D		B	12	1	B
-ensilage		C	60	45 D		7	12	1	A
-stover		C	60	45 D		7	12	1	A

A - Do not feed treated forage to dairy animals. If you feed treated forage to other than milking cattle, remove from the treated forage six weeks before slaughter. B - No specific restrictions. C - Do not use treated corn for ensilage or stover for dairy cattle. Fattening cattle can be fed granule-treated ensilage or stover (one treatment only), but not within 90 days of market. Fattening cattle should not be fed sprayed ensilage but may be fed stover sprayed once if they are removed from the treated stover 90 days before market. D - One application only.

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CONDENSED INSECTICIDE RECOMMENDATIONS FOR

CLOVER AND ALFALFA INSECTS[1]

Insect	NHE No.	Approximate time of attack	Insecticide[2] Name	Lb. actual per acre	Placement	Timing of application
Clover leaf weevil	12	March-April	Lindane Toxaphene	1/4 gamma 1 1/2	On foliage	When larvae are numerous and damage is noticeable, usually early to mid-April. For fall treatment, use DDT.
Spittlebug	13	Late April, early May	Lindane Methoxychlor	1/4 gamma 1	As foliage spray	When bugs begin to hatch and tiny spittle masses are found in crowns of plants. For fall treatment, use DDT.
	(Thiodan, 1/4 lb., will be recommended upon label approval.)					
Aphid	14 19	April-May	Demeton Malathion Parathion Phosdrin	1/4 1 1/4 1/8-1/4	On foliage	When aphids are becoming abundant. Parathion, phosdrin, and demeton should be applied only by professional operators.
Leafhopper	22	Early July	Methoxychlor	1	On foliage	When second-growth alfalfa is 1 to 6 inches high, or as needed.
Garden webworm	42	July-August	DDT Methoxychlor Toxaphene	1 1/2 1 1/2 1 1/2	On foliage	When first damage appears. Use methoxychlor on hay crops and DDT or toxaphene on new seedlings.
Cutworm	77	April-June	Toxaphene	1 1/2	On foliage	Observe residue precautions. Cut, remove hay, and spray immediately.
Armyworm	21	May-June-September	Methoxychlor	2	On foliage	Will not kill worms, but keeps them from feeding.
Seed crop insects	68 73	July-August	DDT	1 1/2	On foliage	No later than 10% bloom.
Grasshopper	74	June-September	Toxaphene Malathion	1 1/2 1 (for dairy forage)	On foliage	When grasshoppers are small and before damage is severe.
Sweet clover weevil	15	April-May	DDT Aldrin granules Dieldrin " Heptachlor "	1 1/2 1/2 1/4 1/2	On foliage On new seedings With seed	When 50% of foliage has been eaten. At planting with seed.

1/ Do not apply insecticides when insects are pollinating these crops.
2/ Observe residue precautions on the labels.

RESTRICTIONS ON USE OF RECOMMENDED INSECTICIDES ON FORAGE CROPS

This table gives the required time interval in days between application and pasturing or harvesting of the crop. Further limitations or qualifications are listed in the footnotes. READ LABELS AND FOLLOW PRECAUTIONS.

	Aldrin	DDT	Demeton	Dieldrin	Endrin	Heptachlor	Lindane	Malathion	Methoxychlor	Parathion	Phosdrin	Toxaphene
Alfalfa - hay			21 1/				28 2/	7	7	15	1	B
Clovers - hay	3/	A	21 1/	3/		3/	28 2/	7	7	15	1	B
Pastures		A	21 1/				28 2/	7	7	15	1	B
Seed crops	C	C	C	C	C	C	C	C	C	C	C	C

A - Do not feed treated forage to dairy animals or livestock being fattened for slaughter.

B - Do not feed treated forage to dairy animals. If you feed treated forage to other than milking cattle, remove from the treated forage six weeks before slaughter.

C - No specific restrictions.

1/ Once per cutting only. 2/ Do not apply when growth is over 4 inches. 3/ For sweet clover weevil, apply to soil.

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CONDENSED INSECTICIDE RECOMMENDATIONS FOR

INSECT PESTS OF SMALL GRAINS

Insect	NHE No.	Approximate time of attack	Insecticides: Name	Lb. actual per acre	Placement	Timing of application
Grasshopper	74	June, July, August	Aldrin Dieldrin Toxaphene	1/4 1/8 1 1/2	On entire plant	Control early while hoppers are small and before they scatter over a wide area. Do not use on forage crops.
Chinch bug	35	June-July	Dieldrin Endrin	1/2 1/4	General, but at ground level is best	When bugs are damaging grains and during migrations. Treat strip in grain to protect corn.
Armyworm	21	May-June	Dieldrin Toxaphene	1/4 1 1/2 to 2	On foliage	When worms are still small and before damage is done.
Greenbug		May-June	Parathion	1/4	On foliage	When needed, and by professional operators only.
Hessian fly		October-April-May	Phorate (Thimet)	1	At seeding	10 lb. of 10% granulas in drill row with a grass-seeder attachment.

RESTRICTIONS ON USE OF RECOMMENDED INSECTICIDES ON GRAIN CROPS

This table gives the required time interval in days between application and pasturing or harvesting of the crop. Further limitations or qualifications are listed in the footnotes.

	Aldrin	Dieldrin	Endrin	Malathion	Parathion	Phorate	Toxaphene
Barley - grain	77	7	45D/	7	15	E	14
- straw	30	30	45D/	7	15	E	B
Oats - grain	7	7	45D/	7	15	E	7
- straw	30	30	45D/	7	15	E	B
Rye - grain	7	7	45D/	7	15	E	7
- straw	30	30	45D/	7	15	E	B
Wheat - grain	7	7	45D/	7	15	E	7
- straw	30	30	45D/	7	15	E	B

A - Do not feed treated forage to dairy animals or livestock being fattened for slaughter. B - Do not feed treated forage to dairy animals. If you feed treated forage to other than milking cattle, remove from treated forage 6 weeks before slaughter. C - Do not apply after heads start to form. D - One application only. E - Do not graze treated fields in fall.

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CONDENSED INSECTICIDE RECOMMENDATIONS

NHE 101
Soybeans
1/1/61

SOYBEAN INSECTS

Name	NHE No.	Approximate time of attack	Insecticide			
			Name	Lb. actual per acre	Placement	Timing of application
Bean leaf beetle	67	May, June, August	DDT[1/] Dieldrin[1/] Toxaphene[1/]	1 1/2 1/4 1 1/2	On foliage	When leaf feeding becomes severe and plants are being killed, or when pods are attacked.
Grape colaspis	34	May-June	Aldrin Heptachlor	1 1/2 1 1/2	In soil prior to seeding	On second-year beans or beans after clover.
White grub	23	June-September	Aldrin Heptachlor	3 3	As soil treatment	Two weeks before planting; 1 or 1 1/2 lb. will not kill large grubs.
Clover root curculio adult	71	May-June	DDT	1 1/2	On marginal rows	Usually when adjacent clover field is plowed up, this pest migrates to adjoining beans.
Grasshopper	74	June-September	Aldrin[2/] Dieldrin Toxaphene	1/4 1/8 1 1/2	On foliage	When migration from adjoining crops begins. For border spray, use 1 1/2 to 2 times as much, and preferably dieldrin or toxaphene.
Flea beetle		May-June	DDT Dieldrin Toxaphene	1 1/2 1/4 1 1/2	On foliage	Plants usually attacked in seedling stages. Treat when needed.
Green clover worm	75	August	DDT Toxaphene	1 1/2 1 1/2	On foliage	When damage appears and small worms are numerous.
Webworm	42	June, July, August	DDT Toxaphene	1 1/2 1 1/2	On foliage	When damage appears and small worms are numerous.

1/ When used as grain only, there are no specific restrictions.
2/ Do not apply within 30 days of grain harvest.

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CONDENSED INSECTICIDE RECOMMENDATIONS FOR

CATTLE INSECTS

NHE 102
Livestock
1/1/61

Animal	Insect	NHE No.	Insecticide[1]	Concentration	Finished spray per animal	Timing of application
Non-milking cattle	Lice and mange	18	20% lindane concentrate	1 pt. per 100 gal. of water	1-2 gal.	2 applications at 14-day intervals.
			55-57% malathion concentrate	3 qt. per 100 gal. of water	1-2 gal.	2 applications at 14-day intervals.
	Stable flies Horn flies	59 61	60% toxaphene concentrate	5 pt. per 100 gal. of water	1-2 qt.	7-14 day intervals. Provides only partial control of stable flies.
	(Backrubbers saturated with 5% DDT or toxaphene in oil give practical control of both horn flies and lice.					
	Horn flies Stable flies Horse flies	61 59 60	Killing and knock-down agents in combination with repellents like Tabatrex and R-326 may be used effectively as dilute sprays at 1-2 qt. per animal 2 or 3 times weekly, or as ready-to-use oil-base sprays at 2 oz. per animal per day or in oil-base forms in an automatic-treadle sprayer. Follow specific directions on label.			
	Face flies		Use cloth-wrapped backrubbers saturated with 5% DDT or toxaphene in a light-grade fuel oil.			
Milking cattle	Lice	18	5% rotenone	2 lb. per 100 gal. of water	1-2 gal.	2 treatments at 14-day interval.
			Rotenone-sulphur dust	0.5-1.0%	6 oz. of dust per animal	Repeat treatments as needed.
	Horn flies Stable flies Horse flies	61 59 60	Same as for beef cattle.			
	Face flies		Apply a 0.2% DDVP sirup bait daily to the foreheads with a six-inch stroke of a one-inch-wide brush.			
Cattle	Grubs		5% rotenone powder	7 1/2 lb. per 100 gal. of water	2 gal.	Monthly, December through April. Spray at 300-400 p.s.i. or add detergent to spray mix.
			1 1/2% rotenone dust	1 1/2% dust	3 oz. of dust per animal	Monthly, December through April. Rub vigorously over affected areas.
	(Two systemics, Bayer's 21/199 and ronnel, are available and satisfactory but are approved for use only on beef cattle.)					

1/ Wettable powders may be substituted for emulsion concentrates if the finished spray is agitated. Recommendations are purposely simplified on this chart.

1960 RESTRICTIONS FOR RECOMMENDED INSECTICIDES APPLIED TO CATTLE

	Alle-thrin	Bayer 21/199	DDT	DDVP	Lethane	Lin-dane	Mala-thion	Methoxy-chlor	Pyre-thrins	R-326	Ron-nel	Rote-none	Taba-trex	Tha-nite	Toxa-phene
Dairy cattle	A			A	A				A	A		A	A	A	
Beef cattle	A	B	C	A	A	D	A	A	A	A	E	A	A	A	F
Breeding herd	A	B	C	A	A	D	A	A	A	A	E	A	A	A	F

A - No restrictions.
B - Allow 60 days between treatment and slaughter. Do not treat sick animals or calves less than six months old.
C - 5% in oil in backrubbers only. Allow 30 days between treatment and slaughter.
D - Do not apply within 30 days of slaughter.
E - Allow 60 days between treatment and slaughter. Give animals access to feed and water before and after treatment. Do not treat sick animals.
F - Do not apply within 28 days of slaughter.

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CONDENSED INSECTICIDE RECOMMENDATIONS FOR

INSECTS ON SWINE, SHEEP, AND POULTRY

NHE 103
Livestock
1/1/61

Animal	Insect	NHE No.	Insecticide 1/	Concentration	Finished spray per animal	Timing of treatment
Swine (do not treat pigs until after weaning)	Mange and lice		20% lindane concentrate 2/ or	2 1/2 pt. to 100 gal. of water	1-2 qt.	2 applications at 14-day intervals.
			55-57% malathion concentrate 3/	3 qt. to 100 gal. of water	1-2 qt.	2 applications at 14-day intervals.
Sheep	Ticks, lice and scab	53	25% DDT concentrate (not for scab) 2/	2 gal. per 100 gal. of water	Spray to saturation. Dips use 1/2 strength.	
			20% lindane concentrate 2/	1 pt. per 100 gal. of water	Spray to saturation. Dips use 1/2 strength.	
			60% toxaphene concentrate 4/	3 qt. per 100 gal. of water	Spray to saturation. Dips use 1/2 strength.	
Chickens (gather eggs before treating; do not contaminate feed and water)	Lice	54	55-57% malathion concentrate 3/	10 oz. per 5 gal. of water	Spray roosting areas to run-off. One treatment.	
			4% malathion dust 3/	1 lb. per 40 sq. ft. floor space	Apply to litter and nesting material. One treatment.	
	Common red mite	54	55-57% malathion concentrate 3/	10 oz. per 5 gal. of water	Spray infested house areas. One treatment.	
	Northern fowl mite	54	4% malathion dust 3/	1 lb. per 40 sq. ft. of floor space	Apply to litter, nesting material, and male birds. Use at rate of 1 lb. per 100 male birds.	
			55-57% malathion concentrate 3/	5 oz. per 5 gal. of water	Spray birds, nesting, and roosting areas (1 gal. per 100 birds). One treatment. Use in place of dust when litter is sparse or wet.	

1/ Wettable powders may be substituted for emulsion concentrates if the finished spray is agitated. Recommendations are purposely simplified in this chart. 2/ Do not apply within 30 days of slaughter. 3/ No restrictions. 4/ Do not apply within 28 days of slaughter.

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NHE 104
Livestock
1/1/61

CONDENSED INSECTICIDE RECOMMENDATIONS FOR HOUSE FLY CONTROL

Infested areas	Insect	NHE No.	Insecticide	Amount per 50 gal. water, plus 10-20 lb. sugar	Finished spray per 1000 sq. ft. of surface	Timing of application
In barns	House fly	16	25% diazinon 1/ concentrate	1-2 gal.	2 gal., or to runoff	Every 2-6 weeks during fly season
			25% diazinon 1/ wettable powder	8-16 lb.	"	"
			Diazinon bait 1/	Dry or liquid		Apply to favorite roosting areas as needed.
			12% ronnel 2/ concentrate	4 gal.	2 gal., or to runoff	Every 2-6 weeks.
			24% ronnel 2/ concentrate	2 gal.	"	"
			25% ronnel 2/ wettable powder	16 lb.	"	"
			Ronnel bait 2/	Dry or liquid		Apply to favorite roosting areas as needed.
			Dipterex bait 3/	Dry or liquid		"
			DDVP bait 3/	liquid		"
			Dimethoate will be recommended subject to label approvel			

1/ Remove animals before treatment. Do not contaminate feed and water. Do not use in milkhouse or poultry houses.
2/ Remove animals before treatment. Do not contaminate feed and water. Do not use in milkhouse.
3/ Do not apply within reach of animals or in milkhouse. Use only as bait.

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CONDENSED INSECTICIDE RECOMMENDATIONS FOR INSECT PESTS OF TURF

Insects	NHE No.	Approximate time of attack	Insecticides: Name	Lb. actual per 10,000 sq. ft.	Lb. actual per acre	Placement	Timing of application
True white grubs	23	May-Oct.	Aldrin	0.75	3.0	On soil surface	Established sod: if used as a spray, water in thoroughly. Granules need no watering. Apply preferably in early spring or late fall. New seeding: mix in soil prior to seeding.
Annual " "	23	May, Aug.-Oct.	Chlordane	2.5	10.0		
Japanese beetle larvae	32	" " "	Dieldrin	0.5	2.0		
Green June beetle larvae		" " "	Heptachlor	0.75	3.0		
Ants		May-Oct.					
Cicada killer wasp	79	June-Aug.	......as for grubs......			On soil surface	As for grubs. For individual nests, pour 3% chlordane in nest after dark. Seal in with dirt.
Earthworms		April-July	Chlordane	2.5	10.0	On soil	As for grubs.
Sod webworms	42	July-Oct.	DDT	1.25	5.0	On grass	The more water used, the better the control.
			Chlordane	0.6	2.5		
Armyworms and	21	May-June &	Dieldrin	0.125	0.5	On grass	As spray or granules.
cutworms	77	Sept.-Oct.	Toxaphene	0.50	2.0		
Chinch bugs	35	June-Aug.	Dieldrin	0.125	0.5	On grass	Sprays or granules. Use plenty of water as a spray.
Leafhoppers	22	July-Aug.	DDT	0.25	1.0	On grass	As a spray.
Mites	58	July-Sept.	Kelthane	0.125	0.5	On grass	Thorough coverage needed. 75 to 100 gal. water per acre.
			Malathion	0.4	1.25		
Chiggers		May-July	Kelthane	0.125	0.5	On grass	Good coverage required. Use minimum 20-25 gal. water per acre.
			Dieldrin	0.2	0.8		
			Lindane	0.125	0.5		
			Toxaphene	0.5	2.0		

Insects	NHE No.	Approximate time of attack	Insecticides: Name	Lb. actual per 10,000 sq. ft.	Lb. actual per acre	Placement	Timing of application
Thrips		July-Sept.	DDT	0.5	2.0	On grass	Control rarely needed.
Slugs	84	June-Oct.	......Slug baits......			Scatter in grass	Where slugs are numerous.
Sowbugs		June-Oct.	DDT	0.5	2.0	On grass	Lots of water needed. Control rarely needed.

PRECAUTIONS: Most insecticides are poisonous. Be sure insecticides are clearly labeled. Keep them away from children and pets. After applying an insecticide, do not allow children and pets on the lawn until the insecticide has been washed into the soil by sprinkling, and the grass has dried completely. To protect fish and wildlife, do not contaminate streams, lakes, or ponds with insecticides.

One gallon of insecticide contains the following amounts of active ingredient: 25% DDT, aldrin, or heptachlor, 2 lb.; 45% chlordane, 4 lb.; 15% dieldrin, 1.5 lb.; 55-57% malathion, 5 lb.; 18 1/2% kelthane, 1.5 lb.; 60% toxaphene, 6 lb.; 20% lindane, 1.6 lb.

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